PETROLEUM PROCESSING

including Petrochemical Processing Section

AUGUST 1954

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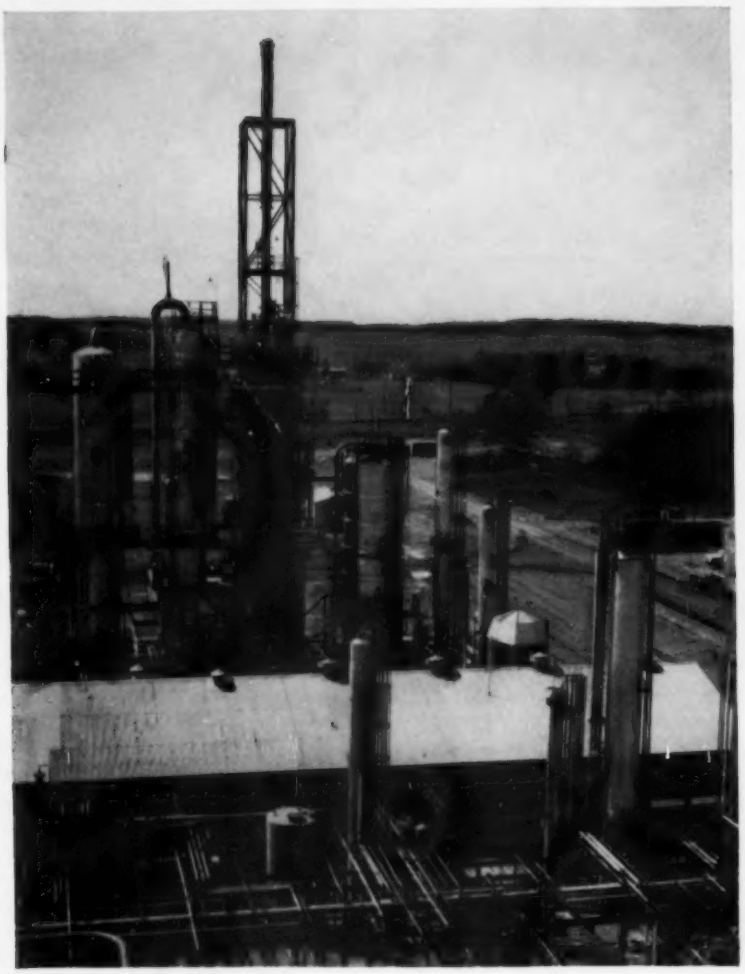

Small and Compact—
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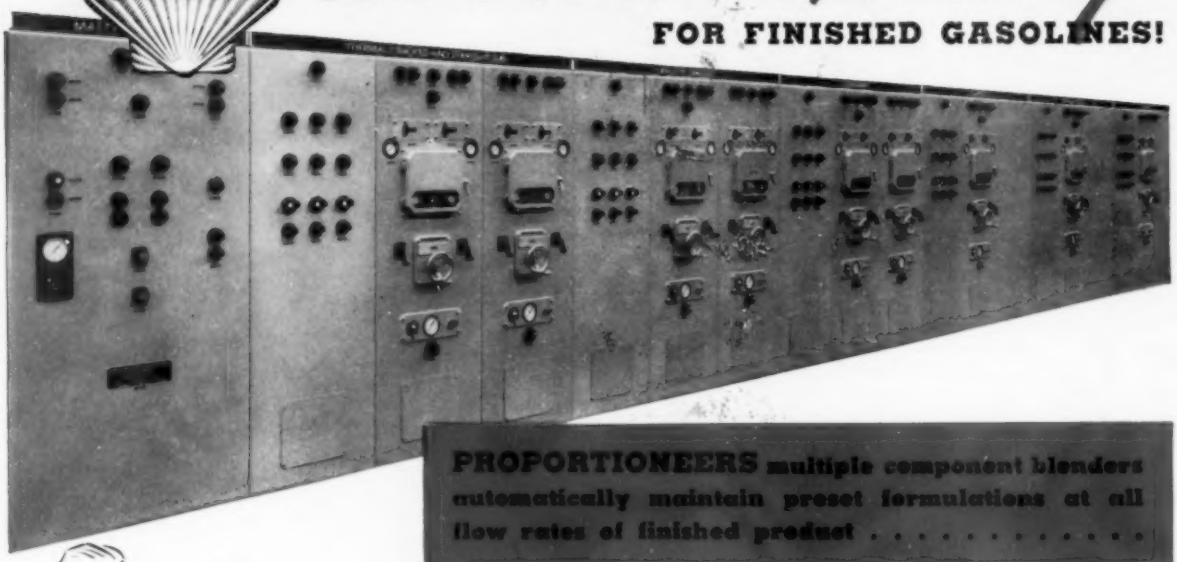
SHELL USES *Stream Blending* FOR FINISHED GASOLINES!



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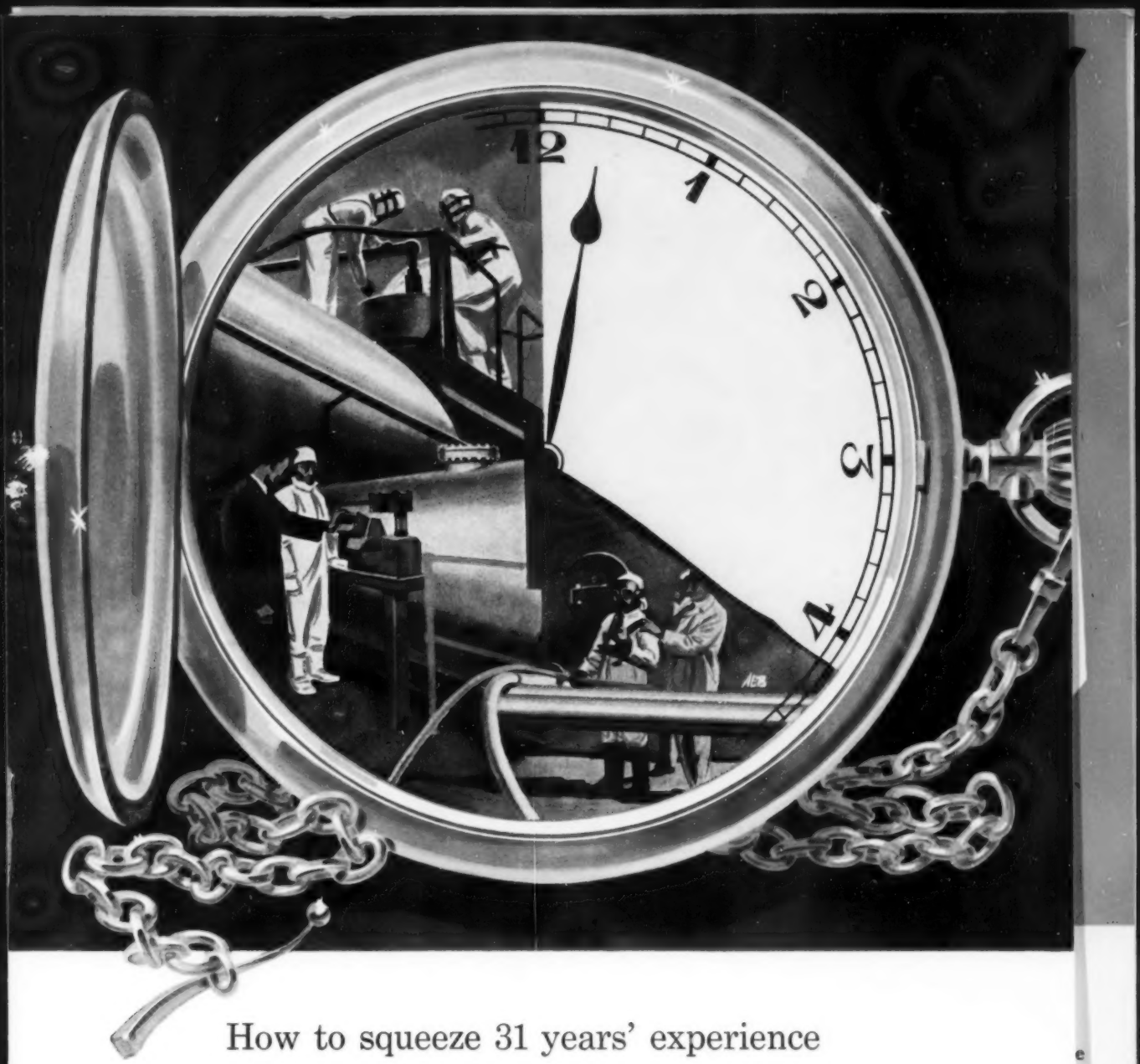

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The first film of the program—a color animation—covers the operation of a mixing plant. Since its release some months ago, it has become an important

(*Continued on next page*)

Printed in U. S. A.

(*Continued from preceding page*)

part in the personnel training of many companies. Our second film, entitled "Safety Precautions and Medical Regulations," is also in color and will be ready for release shortly.

Any of our safety engineers will welcome the opportunity of discussing with you how these films may be fitted into your own safety program. More films are planned for the future—each to run about the same length of time and each to cover a different phase of working with "Ethyl" antiknock compound.

To our way of thinking, safety service is one of the most important services we render our customers. Every year brings a fresh crop of young, inexperienced workers who must be taught to believe in accident-proof methods. And, of course, the interest of the experienced workers in playing it safe must be maintained at all costs.

We share with the petroleum industry the firm conviction that people are its greatest investment. We are confident that our new training tools will enable our safety engineers to assist you in doing an even better job of protecting that investment in the future.

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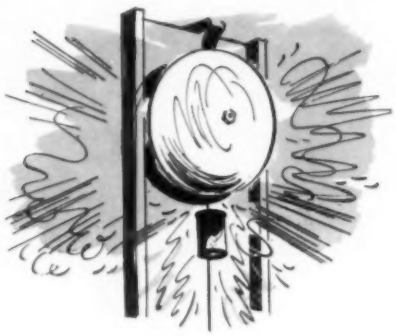
WORTH NOTING



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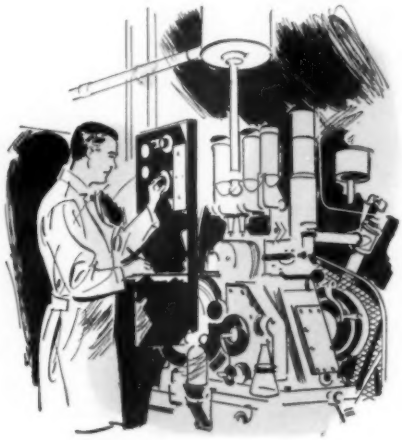

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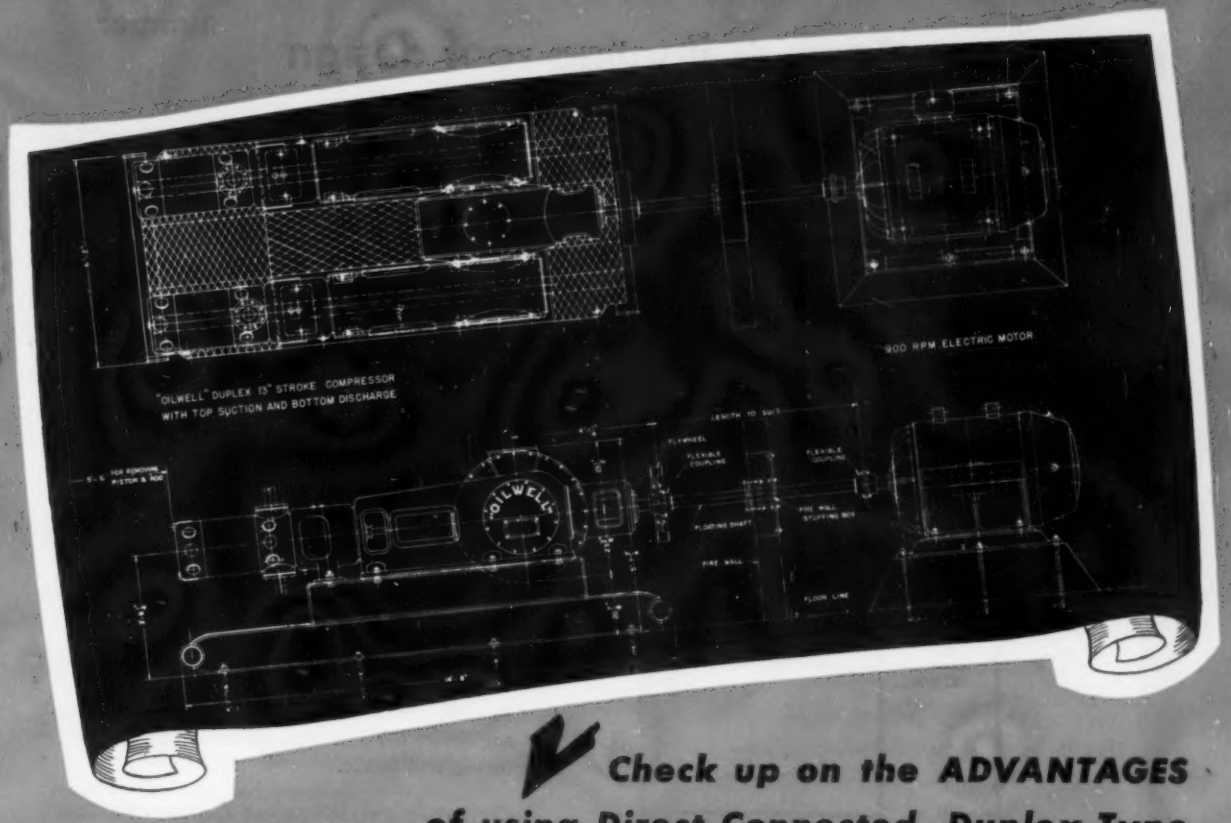

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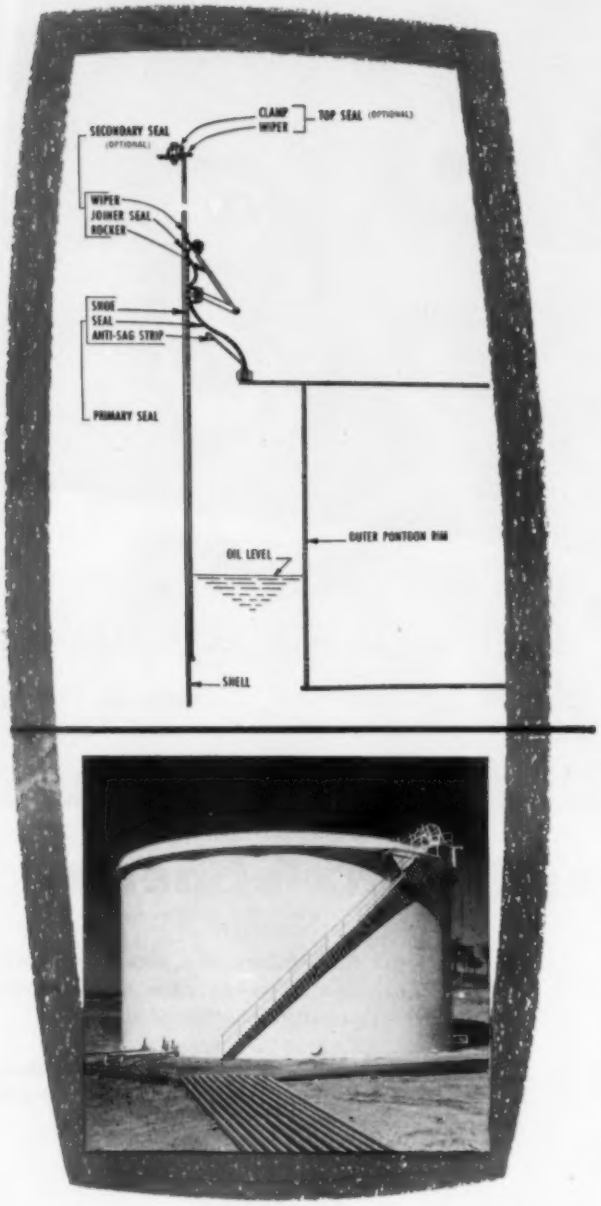

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PETROLEUM PROCESSING

Covering petroleum and petrochemical research and the design, construction, management, operation and maintenance of plants processing hydrocarbon materials into fuels, lubricants and chemicals.

August, 1954
Vol. 9, No. 8

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How Teamwork Sharpens Our Articles

SELDOM does a staff writer for PETROLEUM PROCESSING work alone on an assignment. In fact, he often secures a lot of essential help for his task not only from his fellow staffers but also from the editors and writers of our sister publications—*National Petroleum News* and *Platt's News Service*.

For instance, when the article on refineries coming to the Upper Midwest was being shaped up for this issue, (pg. 1185), "Len" Castle, *NPN's* Midwest Editor in Chicago, virtually doubled as a reporter for PETROLEUM PROCESSING. Len spent considerable time in the field studying the changes in product marketing which are beginning to result from the opening of the new Williston Basin area. We asked him to keep his eyes open for us, too, and he supplied us with rather lengthy notes on important refining developments and trends which he learned about.

Frank Sturtevant, another *NPN* man, passed along to us pertinent information on how Canadian crude ties into the picture—data which he secured during a week spent in Canada studying market trends in the southern part of that country. From the *Oilgram* news bureau staffs came data on crude and product rates via pipeline, barge and rail that give a good inkling of the competition the new refineries will experience when they go after business in the states that will be served from the new fields.

I don't want to give you the impression that the *NPN* and *Oilgram* staffs prepared our article for us. Their help was only a good start, and the data they supplied was the background that guided the PETROLEUM PROCESSING writer in making his own interviews and digging up the basic material for his own article. The point I do want to make is that the editors of this magazine are associated with a group of writers who live with the daily developments in the petroleum industry, and who can bring us expert help on many a subject that has to do primarily with refining.

The teamwork that comes from this group makes it possible for us to prepare comprehensive articles on current industry developments in much shorter time that would otherwise be possible.

In addition, the criticism and judgment we many times secure from the staffs of our associated publications is insurance for you that an article is accurate and mature, and represents much more than one man's opinion of what is going to happen.

William F. Bland

Editor

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What's Happening...

in Refinery Expansion

. . . **Time table for reactivating synthesis plant** at Brownsville, Texas, which Stanolind Oil & Gas recently took over from Carthage Hydrocol, calls for having it on stream in late summer of 1955. Lummus Co., which has contract for rehabilitating plant, shut down for over a year, expects to get started in the field the first part of this month (August), doing just enough in the way of new equipment, maintenance and repairs to get the plant going. First phase of operations will involve getting the plant up to original design capacity of 64-million cu. ft. of gas feed per day, and second phase will be to modify processing equipment to iron out bugs which continually beset Carthage Hydrocol.

. . . **Avtane Refining Co.,** a new firm organized with officials in Dallas, Texas, has received approval for fast tax write-off on a 10,000 b/d refinery near Freeport, Texas, with cost of project pegged at $15,694,000.

. . . **Ashland Oil & Refining Co.** has awarded contract for design and construction of 6000 b/d Houdriformer and prefractionation section at Catlettsburg, Ky., refinery, to Catalytic Construction Co. Work is scheduled for completion in about 11 months.

. . . **Standard Oil Co. (Indiana)** has been granted fast tax write-off on 8000 b/d coking unit and auxiliaries at Wood River, Ill. Total cost is $3,000,000.

. . . **Eastern States Petroleum Co.** will build a 3,000 b/d Unifining unit at Houston under license from Union Oil Co. of California and Universal Oil Products Co., designed to desulfurize and upgrade cracked gas oil. Completion is expected by next September.

. . . **Sun Oil Co.** has been granted fast tax write-off approval for its expansion projects at Toledo and Marcus Hook [What's Happening, May, p. 627]. Total project cost is almost $16,500,000.

. . . **California Oil Co.'s** newly completed 10,000 b/d UOP Platformer has been put on stream.

in Petrochemicals

. . . **Texas Butadiene & Chemical Corp.,** newly formed, will build $30,000,000 combination butadiene and alkylation plant in Houston area with initial capacity of 40,000 ton/yr of butadiene and thus far unannounced alkylate output. Butane will be principal raw material. Houdry dehydrogenation process will make butylenes and butadiene with Phillips furfural solvent extraction process for purifying the latter.

R. L. Purvin of Purvin & Gertz, Dallas consulting engineers, is president. Participants in new firm include Fluor Corp. Ltd. (who are to do the building of the plant); Carl M. Loeb of Rhoades & Co., New York; Wm. R. Staats & Co., Los Angeles; Wertheim & Co., New York; and Warren Petroleum Co., Tulsa.

. . . **Olin Mathieson Chemical Corp.** is now reality, as result of stockholders' approval of merger between Olin Industries, Inc., and Mathieson Chemical Corp.

. . . **Columbia River Chemicals, Inc.,** a new firm, has awarded Fluor Corp. design and construction contract for $12,000,000 plant near Pasco, Wash. Plant will use barged-in Bunker C fuel oil to produce 160 ton/day of anhydrous ammonia, 100 ton/day of urea, and 140 ton/day of ammonium sulfate. It is designed to use natural gas for ammonia manufacture when it becomes available in Washington. Pacific Chemicals, Ltd., of Calgary, has interest in venture, and financing is being arranged through New York Life Insurance Co.

. . . **Hercules Powder Co.** has begun producing anhydrous ammonia at the former government ordnance plant it acquired at Louisiana, Mo. Hercules now is studying facilities for possibilities of making other chemicals, among them methanol, formaldehyde, and pentaerythritol, and sees this as feasible economically.

. . . **Hercules Powder Co.** has under construction a new plant at Burlington, N.J., for producing approximately 12,000,000 lb. annually of dimethyl terephalthalate. Expected completion of the $4,500,000 unit is spring of 1955.

. . . **Standard Oil Co. (Indiana)** is converting an existing phenol extraction unit to a Udex extraction system, with completion scheduled for June, 1955. Unit will produce concurrently 845 b/sd of benzene, 1446 b/sd of toluene, and 712 b/sd of xylenes.

. . . **Columbia-Southern Chemical Corp.** has started building $3,000,000 ammonia plant at Natrim, W. Va., with completion expected by April, 1955. Design and construction is by Chemical Construction Co.

in Transition

. . . **Further signs of all-industry union** were seen as merger discussions began last month between O. A. Knight's Oil Workers International Union and the Gas, Coke, and Chemical Workers (both CIO).

. . . **Deep Rock Oil Corp.** has arranged to sell most of its refining, crude oil pipe line, producing leases and royalties, and marketing properties to General American Oil Co. of Texas, for $22,000,000, plus 100,000 shares of common stock of General American Oil. In turn, all refinery, pipe line, and marketing prop-

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

erties are to be leased back to Deep Rock for eight years at annual rental of $250,000.

Deep Rock board accepted offer, and shareholders will vote on the proposal Sept. 7.

in Foreign Operations

. . . **Commonwealth Oil Refining Co.** has begun construction of complete, new, 25,000 b/d refinery at Guayanilla Bay, 15 miles west of Ponce, Puerto Rico, at approximate investment cost of $24,500,000. The Lummus Co. is contractor. Facilities include two-stage distillation unit, Houdry catalytic reformer, Houdry cat cracker, vapor recovery, alkylation, and polymerization units. Products will be aviation and motor gasolines, LP gas, kerosine, Diesel and fuel oils. Dockage will be able to handle super-tankers.

. . . **British American Oil Co.** has awarded contract to Fluor Corp. of Canada Ltd., for construction of a 2000 b/d catalytic reformer at its 7200 b/d refinery at Calgary, Alberta. Estimated cost, including offsite facilities, is $725,000. Completion is scheduled for February, 1955.

. . . **Wainwright Producers and Refiners, Ltd.,** has awarded Fluor Corp. of Canada, Ltd., a contract for expansion of 800 b/d refinery at Wainwright, Alta., to 3800 b/d. Contract includes new crude still, a visbreaker and blending plant.

. . . **First section of world's largest oil-from-coal** plant, $84,000,000 SASOL project, has started operating at Johannesburg, So. Africa. Other sections are scheduled to go onstream in next few months.

. . . **Compahnia de Petroleo da Amazonia** has awarded $4,000,000 contract to Southwestern Engrg. Co. for construction of a complete 5,000 b/d refinery at Manaus, Brazil. Plant, scheduled for completion in late 1955, will include UOP fluid type cat cracker, topping unit, drum and can plant, and auxiliaries.

. . . **First catalytic cracking unit in North Africa** has been placed in operation by Societe Cherifienne des Petroles at Petitjean, French Morocco. Unit has a crude capacity of about 5,000 b/d.

. . . **Shell Refining & Marketing Co.** has started construction of new 5760 b/d Platformer at Shell Haven refinery, Essex, England, with completion scheduled for end of 1955.

. . . **International Petroleum Co.** has put onstream new 45,000 b/d pipe still and 4000 b/d depropanizer at Talara, Peru. Arthur G. McKee & Co. was general contractor.

. . . **Arabian American Oil Co.** is building new Fluid hydroformer of 21,500 b/d capacity at Ras Tanura, Saudi Arabia, at cost of about $12,750,000, with completion scheduled for next July 1. Lummus Co. Ltd. is doing engineering under direction of Aramco.

in Markets and Prices

. . . **An already gloomy oil market picture** became even more dismal in July. Longstanding weakness in refined products prices gave way to reductions for gasoline, distillates, and heavy fuel in both coastal and inland markets; and crude oil continued to be watched closely.

. . . **General reduction in gasoline tank wagon prices** by major suppliers in amounts ranging from 0.1¢ to 1.5¢/gal. covered the entire eastern seaboard area from Maine to Louisiana, as well as Ohio and Canada.

Lower prices, however, failed to stimulate open market trading. Nor was there much increase in shipments under contracts.

. . . **Downward price trend began in the east** with prices off 0.25¢/gal. for distillates and 10¢/bbl. for heavy fuels. New York harbor prices slipped to new lows of 12.45¢ tank car, 11.5¢ barges for 86 oct. regular; 8.95¢ tank car, 8.7¢ barge for No. 2 fuel; and $2.15 bbl. for No. 6 fuel.

Cargo prices at the Gulf for premium gasolines dropped 0.25¢ while lower octanes declined 0.5¢, to 11.75¢ for 95 oct. premium and 9.75¢ for 87 oct. regular. Distillate fuel prices went down 0.125¢ to 0.25¢. In the Mid-Continent area Group 3 gasoline prices declined 0.25¢ gal. and No. 6 fuel hit a new low of $0.95 bbl.

. . . **Ashland Oil & Refining Co.** and its affiliate, Ashland Oil & Transportation, reduced their posted prices for Illinois Basin crude 12¢, and eastern Kentucky 25¢ bbl. Company pointed to high gathering costs in these areas in explaining cuts.

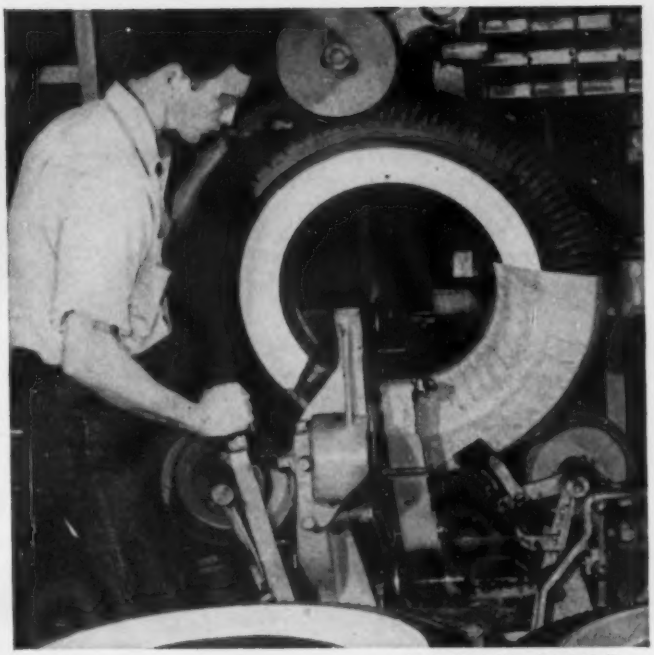
Just before Ashland crude price drop, Sohio Petroleum Co. announced it was reducing its purchases of Illinois, Indiana, and Kentucky crude to 70% of its June takings. Company officials said its crude storage facilities have been steadily filling over many months, and were reaching physical limits of capacity.

Looking Ahead

. . . **Solid petroleum?** Standard Oil Co. (Indiana) has signed contracts with the Air Force to build and operate a pilot plant for certain new types of solid rocket propellants at Seymour, Ind. Makeup of the fuels was not revealed, but company said a large part comes from petroleum sources, and are said to have an advantage in low cost.

. . . **Smog issue flops as political football.** Campaigning as "Your Solution to Smog Pollution," a Los Angeles City Councilman, Ernest E. Debs, lost recently in a try for election to Board of Supervisors of the L.A. County. He had called refiners principal source of air pollution and promised strict fight if elected, including ousting of Gordon P. Larson, head of county's smog-fighting agency.

Motor Oil and Gasoline (Additives)



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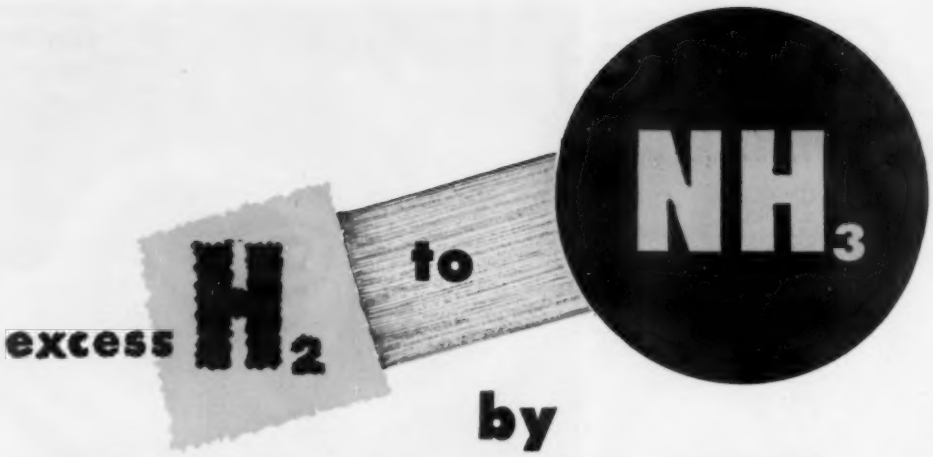
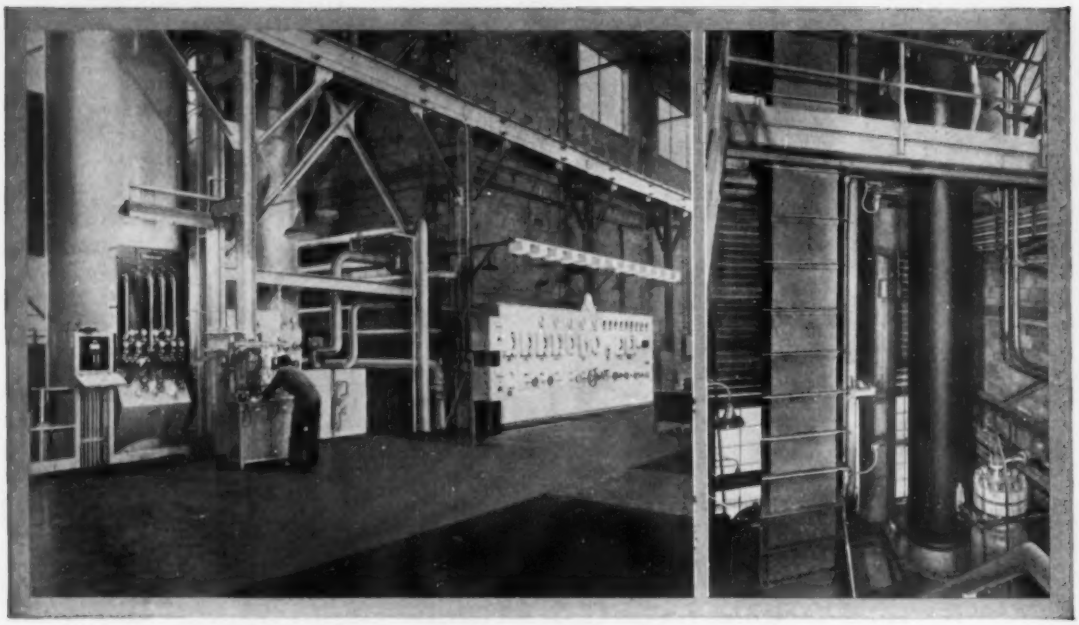


by Casale ammonia synthesis



55 Tons per day of liquid anhydrous Ammonia is being produced at this new plant of the Pennsylvania Salt Manufacturing Company at Wyandotte, Michigan. The Hydrogen is a by-product from Pennsalt's adjacent chlorine plant.

The photographs show the Liquid Air Plant and the control board in the compressor building; also, the Casale ammonia condenser, deoxidation reactor and convertor.

For a general description of this installation, designed, constructed and licensed by Foster Wheeler:

write for HE—4-54

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Wide Range of Fuels Fit Needs of New Passenger Car Gas Turbines

REFINERS who keep a weather eye on Detroit activities in the gas turbine field have been seeing some significant developments on the part of the automotive engineers. Not too long ago General Motors showed its hand by announcements of its work on such power plants for busses.

Even more significant in many ways has been the work of GM's bigger competitors. Chrysler has been developing what it sees as a very satisfactory gas turbine for passenger automobiles.

Gas turbines for practical passenger car use are over their biggest hurdle, according to Chrysler. This is the reduction of their fuel consumption to about what the average driver achieves with a conventional piston type gasoline engine.

Fifteen miles/gal at 40 mph. is the rate achieved by a stock model Plymouth experimentally equipped with a gas turbine, says Chrysler. With a gas turbine this is part throttle, where this type of driving power is said to be least efficient.(1) Earlier experiments have been mostly with turbine-driven trucks, where fuel consumption at full throttle was only around 2 mpg.

Main factor in fuel savings is said to be a compact heat regenerator developed by Chrysler, which not only gives fuel economy but also reduces the volume of exhaust. Control of the exhaust fumes is another problem to be overcome before gas-turbine automobiles can be numerous on city streets.

In announcing these developments, George J. Huebner, Jr., chief of Chrysler's research division, said: "Automotive gas turbines will come as fast as we can make them."

The reasons for his prediction are: 1) the turbine offers potentials of greater operating efficiency than the piston engine; 2) the turbine has no octane requirements, so it can burn almost any fuel that will flow through a pipe; 3) it has 2½ times the acceleration potential of a piston engine.

What fuels does it use? The Plymouth with the experimental gas turbine has been running on straightrun gasoline. However, it is claimed it will as easily burn kerosine or other middle distillate fuels or residual fuels.

Lube oil requirements also are not far different from those of conventional engines. A low viscosity, high VI oil with superior oxidation qualities has furnished satisfactory performance. Some extreme pressure characteristics are desirable, since the same oil serves to lubricate the turbine's reducing gear.

Because of this fuel-using versatility, Huebner feels that when automotive turbines come on the market they will use the fuel most economical and most readily available.

To meet this latter condition only, the oil companies would not be required to add to their present product distribution facilities. However, if the most economical fuel is desired, the turbines would take the refiners' by-product residuals. To supply these direct to vehicles would require oil companies to take on another product for retail distribution.

Granting that automotive gas turbines are accepted by the public in coming years, the fact remains that fuels will still have to be supplied to the piston type cars which will be on the roads for a long time ahead.

—V.B.G.

(1) "What Gas Turbine Means to Marketers," *National Petroleum News*, July 7, 1954, p. 25.

Automotive Design Advances Are Factor in Markets for Light Ends

DIRECT use in motor fuels may well remain the primary outlet for light hydrocarbon fractions for some time to come, according to the thinking of some oil industry technologists. The volume of light ends at the disposal of the industry is the largest of any time and is increasing almost daily. It is estimated, for example, that there is today an excess of 250,000 to 300,000 bbl. daily of the most common light fraction, the butanes.

Even though the petrochemical markets continue to beckon, and may be expected to grow, some refiners point out that the prime function of the light ends is that of adjusting fuel volatility.

Investigators for Standard Oil Development Co. are of the opinion that refiners are not taking full advantage of the resistance to fuel vapor locking tendencies that the engines of the postwar cars possess.(1) In general, they say, an increase of about 1 lb. RVP would not increase the difficulties of motorists on the road from this cause. This would not provide for any great additional use by refiners of butane, or other light hydrocarbon fractions, but it would seem to imply that progress is being made in the right direction.

The SOD report is based on tests of postwar cars to evaluate their ability to handle volatile gasolines. A survey of the vapor locking characteristics of 50 cars was made in New Jersey and an additional 33 cars were tested in the southwest for comparative purposes. The cars were selected on a statistical basis in accordance with their population on the road in 1953, and they represented about 75% of all the cars on the road in that year.

Comparison of the current test results with a statistical study of prewar cars made by the Esso Laboratories of the Standard Oil Development Co. in 1941 showed two points of difference: "(1) substantial improvements in the ability of cars to use higher volatility fuels have taken place over the years, and (2) prewar cars were limited by idle type of vapor lock in contrast to the acceleration vapor lock limitation of the postwar group.

"The ability of postwar cars to handle more volatile fuels is the overall result of many changes in cars in the postwar period," it is stated, "and indicates the efforts on the part of the car manufacturers to design their vehicles to resist vapor locking. The beneficial changes include the use of new design carburetors, the

placing of the fuel pumps away from engine hot spots and the rerouting of fuel lines.

"As a specific example, one popular 6-cylinder car installed a new carburetor in 1949. The tolerance of the 1949 and later models of this car make is about 2 RVP units greater than the 1946-48 models with the old carburetor."

It is significant that this change has taken place in a period of the advent of air-conditioning and new body styling in passenger cars, both of which conditions would tend to increase underhood temperatures and add to the vapor locking tendency of the fuel.

Based on average volatility figures obtained from interpolating summer and winter volatility data on regular and premium gasolines as given in the Bureau of Mines survey reports, the report concludes, at least a one-pound RVP increase in volatility appears to be possible for the average *gasoline* without causing vapor lock difficulties. —V.B.G.

(1) "Vapor Locking Characteristics of Passenger Cars," R. E. Barnum, P. J. Clarke, J. P. Hamer, Esso Laboratories-Research Division, Standard Oil Development Co., Linden, N.J.: before Summer Meeting, Society of Automotive Engineers, Atlantic City, June 6-11, 1954.

Will Atom-Powered Locomotive Compete with Diesels by 1959?

AN atom-powered locomotive has been designed and cost-estimated which might be economically competitive with Diesel units under certain conditions. The economic question hinges primarily on the unknown cost of Uranium-235, compared with Diesel oil at 11¢ a gal.

The locomotive was designed and costs estimated by a University of Utah physicist and his graduate students, and is reported to be similar in outward appearance to the familiar Diesel.[1, 2] It would be 160 ft. long and weigh 700,000 lbs. and would develop 7000 hp. with final drive via electric motors. A four-unit Diesel weighs about 900,000 lbs. There similarity ends. The "hot-atom" engine would cost $1.2 million and require five years to build. Some 11 lbs. of U-235 fuel would be required annually.

Here are some economic considerations. First off, a muzzled few alone know what U-235 costs the Atomic Energy Commission, where the locomotive would have to be periodically fueled. Replacing the reactor would cost $100,000 in labor, require several months. If the unit were used in average service, it is estimated the locomotive could compete with a Diesel and use fuel costing slightly under $7000 a lb. Should it receive more than average service, say 50% more, it could operate with $11,000 per lb. fuel. If twice the U. S. average, the fuel could cost $14,000 a lb. One source states the minimum cost for U-235 fuel competitive with Diesel is $3175 per lb.

By comparison, a 7000 hp. 4-unit Diesel operating 200 hours a month requires $120,000 worth of fuel annually. Amortization over 10 years plus lubrication and maintenance costs $156,000 more.[2] The largest Diesel locomotive costs about $500,000.

Assuming the above estimates are correct, perhaps refiners should start looking for atomic energy competition for Diesel fuel in 1959. The big stumbling block of finding someone with $1.2 million to invest in a gamble to build the first atomic-powered locomotive may not be so big, considering the interest shown by private industry seeking to participate in the construction and operation of the first full-scale central atomic power plant. —D. P. T.

(1) *Chemical & Engineering News,* March 1, '54, pp. 816-17.
(2) *Newsweek,* Feb. 22, '54, p. 54.

Seeking a Petrochemical Plant Site? Oklahoma Survey May Help

HERE'S a new wrinkle that could mean some interesting trends in the over-all geographical distribution of the American petrochemical processing industry.

It involves the important state business of attracting new industry to locate within its borders, or of promoting the additional use of a state's resources by an existing resident industry. As developed and put into use by the Oklahoma State Planning and Resources Board, it is aimed specifically at the chemical industry.

Essentially, the Oklahoma Board has retained a private company to make for it the same basic type of industrial survey that is commonly used by private enterprise for a proposed plant construction project, but with certain important modifications. Oklahoma has in this case retained the Chemical Plants Division of Blaw-Knox Co. to do the work.

The first survey, completed some time ago, was in the form of a preliminary report evaluating the state's natural resources which could serve as raw materials for chemical manufacture. Also taken into consideration were existing chemical ventures in the state, available, and potential markets. In every case, these were examined from the standpoint of attractiveness to other private ventures.

The list proved to be largely petrochemical. It named between 400 and 500 different materials which could be made from the Sooner State's resources.

Rigorous economic aspects then trimmed this formidable group down to 14 chemicals recommended for further study. In order of economic importance, these included:

Acetylene, ethylene, vinyl chloride, chlorine, nitrophosphates, phenol, cyclohexane, xylenes and phthalic acid, silicones, ammonia, styrene and polystyrene, glycerine, calcium cyanamide and HCN; and hydrogen fluoride.

Important raw materials include refinery and liquefied petroleum gases, salt, oil-field brines, limestone, natural gas, cottonseed and other vegetable oil materials, silica sand, and coal.

A further whittling on the products has been done, and the state is now having Blaw-Knox evaluate four in great detail—ethylene, chlorine, acetylene and ammonia. Evaluations include estimates of investments necessary, sources and requirements for raw materials, utilities and transportation, analyses of manufacturing costs via different routes, existing and potential markets, and potential plant sites. —D.P.T.

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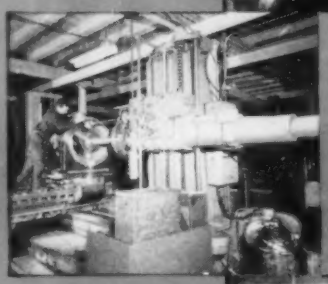

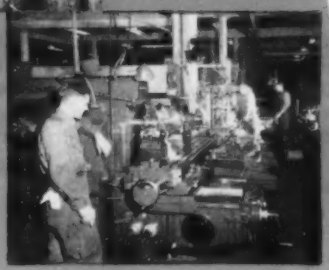

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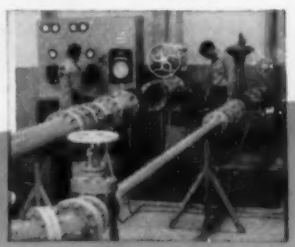

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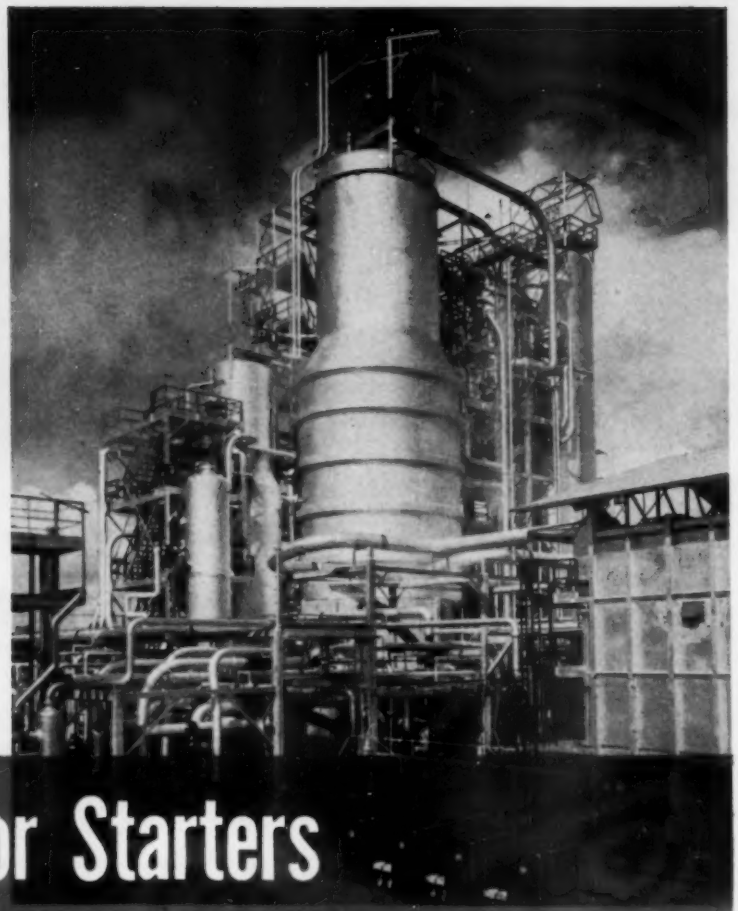
EC&M Bulletin 1062 Type ZHS 2300-volt Motor Starter in Type VIII enclosure for Class I, Group D hazardous atmospheric locations.



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These motor starters have self-contained, adjustable overload relays with inverse-time-element feature which protects motors from overheating as a result of overload, loss of one phase or failure to start. Of combination type, these relays assure instantaneous trip on heavy overloads or short circuits.

EC&M Type ZHS Starters for 2200 to 5000-volt motors are built in 50,000 KVA interrupting capacity and in the VALIMITOR (volt-ampere-limitor) style for use on power systems having infinite KVA.

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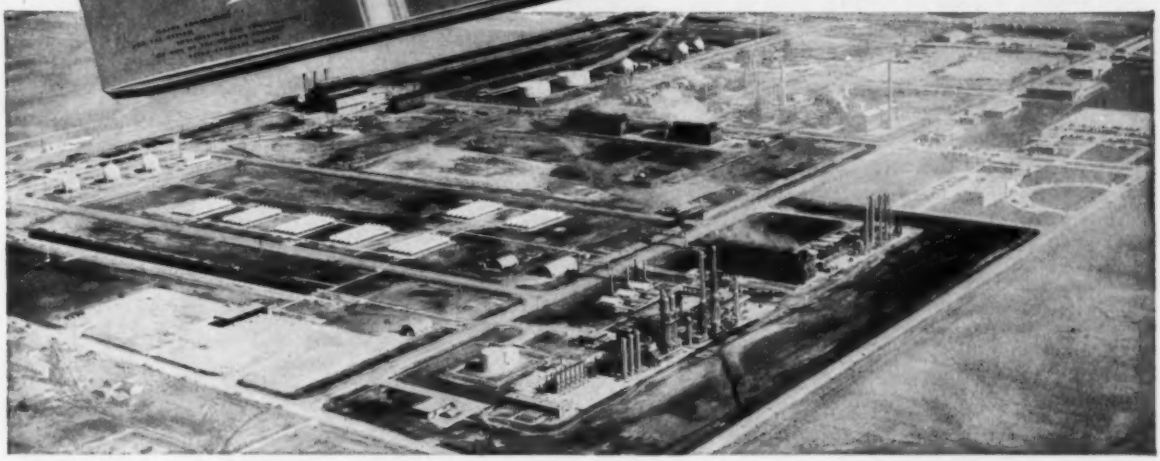

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 (To obtain more data on advertised products see page 1260)

CLAD STEEL RESISTS HIGH TEMPERATURE CORROSION

High sulphur content of varying feeds in this catalytic cracking unit made corrosion resistance vital if maintenance were to be kept down. To meet this threat effectively and *economically*, the equipment engineers recommended the use of clad steel in construction. Type 405 stainless-clad steel gives effective corrosion resistance in the reactor, where temperatures range from 925° to 950°F. In addition, in the lower portion of the fractionating tower, Type 405 stainless-clad stands up to sulphur corrosion at the 650°F. operating temperature.

Even though feeds vary from heavy vacuum gas oil to light gas oil, operation has been continuous except for scheduled yearly inspection shutdowns since the unit went on stream over four years ago. Chances of an unscheduled shutdown or equipment failure interrupting throughput are reduced, and maintenance is held to a minimum. The layer of stainless, permanently and integrally bonded to low-cost carbon steel backing plate, does the job of the expensive solid alloy. Clad steel eliminates the danger of seepage or crevice corrosion.

A wide range of clad steel types makes it easy to meet your processing problems *economically*. Clad steel tanks and pressure vessels minimize first cost, have long, trouble-free life, will withstand high pressures and temperatures, permit easy and economical field erection. A combination of versatile clad steels and modern fabricating techniques, teamed with sound engineering, will give you these benefits. Working in close coordination with your engineers and consultants *from the start*, a qualified fabricator can tailor equipment to your exact processing needs.

Type 405 stainless-clad steel in the lower 92 feet of this fractionating tower resists sulphur corrosion economically at 650°F. At even higher temperatures of 925°-950°F. in the reactor, the same clad steel is used to resist corrosion.

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or, contact Manager, Marketing Service, Lukens Steel Company, 682 Lukens Building, Coatesville, Pa.

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PETROLEUM CHEMICALS DIVISION NEWS

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August ★ *One of a Series of Interest to the Petroleum Industry* ★ *1954*

Research Paves Way for Production and Employment

Over the past quarter century, for every dollar Du Pont has spent for laboratory research, it has spent three dollars in productive facilities.

Research in the same period cost $475 million, exclusive of buildings and equipment. And employment soared from 38,000 to more than 90,000.

During the same span, expenditures for new plants and facilities amounted to $1,400 million. This is a ratio of three production dollars for one research dollar.

New Booklet on Du Pont Metal Deactivator

Many refiners are giving increased attention to the problem of the effect of metals on gum formation. To aid them in solving this problem, the Du Pont

Petroleum Chemicals Division offers a comprehensive new booklet which discusses the aspects of gum prevention.

The booklet traces the sources of metallic contamination. And findings of a recent service station survey on the prevalence of copper and gum in gasolines are included. There are also many helpful hints and detailed instructions on combatting gum formation with Du Pont Metal Deactivator.

Application and Costs

The booklet discusses methods of adding Du Pont Metal Deactivator and quantities needed to prevent metallic reaction. And it presents a cost study on the use of DMD. Other valuable information includes chemical reactions, handling and shipping. In all, there are 20 pages of facts with answers to practically any question you may have regarding the use of DMD.

The new booklet is yours on request from any Du Pont representative or regional office.

Mileage by the roomful to test automotive fuels and lubricants

How is gasoline efficiency affected by high-speed, high-temperature operation?

What happens to a lubricant in the hectic start-and-stop maneuvering through city traffic?

Questions like these become more important today as high-speed superhighways weave a network across the country, and the tangle of city traffic grows more knotty.

DEVELOPING FUELS AND LUBRICANTS FOR TOMORROW'S CARS calls for extensive road testing. To accelerate this work, the Du Pont Petroleum Laboratory has brought the highway indoors with this ingenious chassis dynamometer.

The new chassis dynamometer at Du Pont's Petroleum Laboratory gives interesting answers. It is an important source of information for the automotive engineers taking part in Du Pont's research concerned with additives designed to improve fuel and lubricant performance.

How It's Done

Speeds up to 90 mph can be simulated on the dynamometer. Radiator windage can be synchronized to the simulated speed of the car. Inertia flywheels create road conditions by varying "load."

Five flywheels can exert a load in multiples of 500 pounds up to two and

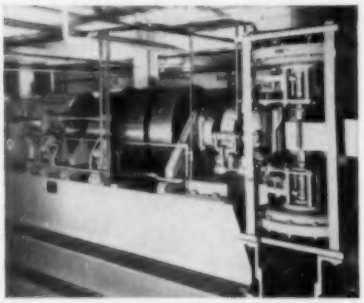
ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

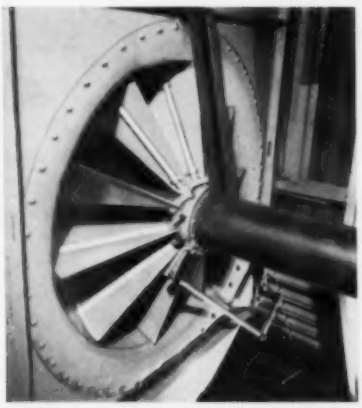
PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED *Dynamometer*

three quarters tons. Engineers operate this versatile setup from a central control panel where detailed data on test factors are also recorded.



THE INERTIA FLYWHEELS, a useful feature of the Petroleum Laboratory's chassis dynamometer, simulate "load" on the car or truck being tested. The two large wheels on the right represent 2,000 pounds each, the next one is 1,000 pounds, and a 500-pound wheel is shown at the left.



THIS FAN is used to generate windage through the car's radiator. It allows the dynamometer to simulate actual radiator operating conditions, at speeds up to 90 mph.

Results

Information learned from tests in Du Pont's new chassis dynamometer will aid in matching vehicles, fuels and lubricants to the changing patterns of modern driving conditions.

As data from these tests are collected and evaluated, they will be made available to the petroleum and automotive industries.

Manager of New San Francisco District

JOSEPH G. EVANS

Because of increasing activity on the Pacific Coast, and as an added service to refiners, a new district has been created by the Du Pont Petroleum Chemicals Division's West Coast Region.

Assigned to the post as manager of the San Francisco District is Joseph G. Evans who joined Du Pont in December 1951.

Mr. Evans is a graduate of Texas A & M and started with Du Pont as a sales-service representative of the Petroleum Chemicals Division in Tulsa, Oklahoma.

Previous to this he was Development Engineer for the Standard Stoker Company of Erie, Pennsylvania, and later formed his own company handling specialized industrial chemicals and automotive lubricants.

Mr. Evans spent three years in the Pacific as an officer in the Naval Submarine Service during World War II. He was later recalled to active duty during 1950-1951 to serve on the destroyer U.S.S. McCaffery off Korea.

Du Pont additive improves diesel fuel production 4 ways

You may know Du Pont Fuel Oil Additive No. 2 as an effective stabilizer and dispersant for distillate heating oils. But do you also know that F.O.A. No. 2 does some remarkable things when added to diesel fuel?

It permits blending of cat-cracked and straight-run stocks. Refiners get more flexibility and greater capacity in diesel fuel production.

Certain amounts of heavy distillate fuel oils treated with Fuel Oil Additive No. 2 can be added to diesel fuel without affecting filterability. In this way the additive permits upgrading of heavy oils.

It reduces particle size of insoluble residues, and retards their formation as well. Result—F.O.A. No. 2 helps to end clogging of diesel filter screens.

The fourth advantage of F.O.A. No. 2 in diesel fuels is that, being ashless, it simplifies the problem of meeting ash specifications. Since it leaves no combustion chamber deposits, it does not contribute to exhaust sparks.

Storage tests indicate that this highly concentrated chemical additive gives most satisfactory results when added to freshly prepared stocks at the refinery.

LITERATURE AVAILABLE

Here is a partial listing of the bulletins, reports, booklets, technical papers and aids available to you through any of the Du Pont Petroleum Chemicals Division regional offices listed below:

Du Pont Fuel Oil Additive No. 2—A 12-page bulletin describing this ashless stabilizer and dispersant which prevents clogging of fuel oil screens . . . A-6522

Du Pont Metal Deactivator — A new, comprehensive, 20-page booklet which discusses every aspect of copper contamination and methods of metallic gum prevention using Du Pont Metal Deactivator, A-7300

Film Library — A new catalog, listing films which are available for oil company use. This listing includes the Du Pont "Cavalcade of America" TV library A-7549

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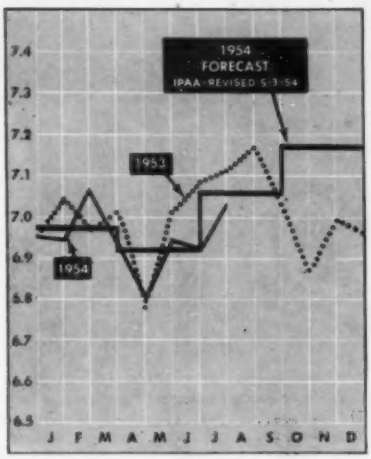
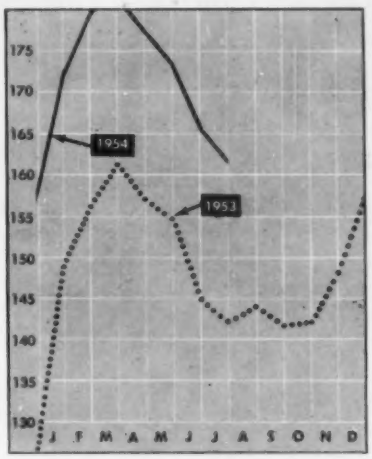
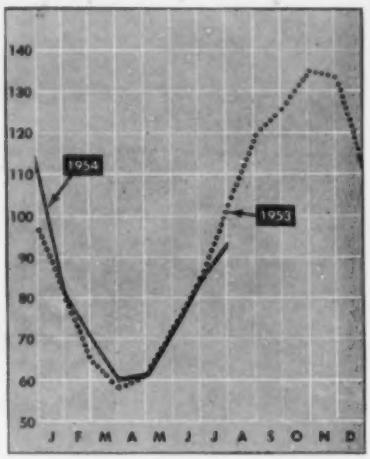


CRUDE RUNS TO STILLS
(Millions of b/d, monthly averages)



PRIMARY GASOLINE STOCKS
(Millions of bbls., end of month)



PRIMARY DISTILLATE STOCKS
(Millions of bbls., end of month)

Further Cuts in Runs by Many Plants

OUTLOOK: Runs to stills will be under forecasts for the third quarter—Still, gasoline stocks will be at burdensome level when summer ends—Heating oil inventories moving into satisfactory position for fall except on Gulf Coast.

Crude: The handwriting on the wall became clearer in July as the third quarter opened. Refiners' gasoline inventories were then farther above the 1953 level than at the start of the withdrawal season three months earlier. Heating oil stocks were moving toward a position by fall that should allay any general anxiety as to the adequacy of supplies, particularly in view of the surplus still capacity to be put into use then, if needed.

So, when runs to stills moved upwards as the third quarter opened, many refiners individually reduced their own operations and publicly announced this fact. The Texas Railroad Commission, along with words of warning, reduced the allowable crude production in that state for August by 121,642 b/d, bringing the total reduction since April to nearly 400,000 b/d.

Gasoline: There has been little change in gasoline production at refineries from a year ago. Plant output, however, is at the point where, together with a lower demand than was earlier estimated, it comes closer to meeting current needs. As a result, early in July U.S. refiners' inventories of gasoline were over 21,000,000 bbls. higher than a year ago, with most of the increased inventories being in the area east of California.

The Ind.-Ill.-Ky. district is long on gasoline supplies. The 36,800,000 bbls. in storage there early in July were over 8,700,000 bbls. (31%) greater than at the same time in 1953.

Heating Oils: U.S. refiners' stocks of kerosine and distillate on June 30 were 113,350,000 bbls., while 118,000,000 bbls. was earlier forecast as desirable for that date, and looking toward fall and winter needs. The lag is mainly in the Gulf Coast district, where stocks July 9 were 20,234,000 bbls., 4,537,000 bbls. (18%) less than on July 11, 1953. Inventories in the Ind.-Ill.-Ky. district were 3,668,000 bbls. (17%) higher than on July 11, 1953. For the U.S., July 9th inventories, 119,797,000 bbls., were 1,400,000 bbls. higher than on July 11, 1953.

KEY STATISTICS

(Figures given in terms of millions of b/d, monthly averages, except stocks, which are in millions of bbls. at end of month)

	July 1954*	June 1954	July 1953
CRUDE OIL			
U. S. Production	6.308	6.486	6.603
Imports	.686	.601	.629
U. S. Stocks	277.748	278.628	284.976
Runs to Stills	7.040	6.939	7.103
GASOLINE			
Refinery Output	3.402	3.375	3.501
Refinery Demand	3.754	3.730	3.691
Primary Stocks	161.786	165.577	142.068
HEATING OILS			
Refinery Output	1.714	1.679	1.736
Refinery Demand	.979	1.122	1.059
Primary Stocks	125.112	113.348	132.889
RESIDUALS			
Refinery Output	1.146	1.162	1.224
Imports	.286	.291	.288
Total Supply	1.432	1.453	1.512
Primary Demand	1.258	1.316	1.408
Primary Stocks	53.355	50.564	47.530

*Through July 16, except Crude Stocks, which are B. of M. data one day later.

PRODUCT AND CRUDE PRICES

Products—¢/gal, weighted average prices in principal refinery markets
Crudes—$/bbl., principal fields
Source-Platt's Oilgram Price Service

	July 1954*	June 1954	July 1953
Gasoline	11.43	11.72	12.46
Distillates	8.69	8.93	9.05
Kerosine	10.26	10.33	10.44
Residual	3.73	3.80	3.88
Above 4 Products	8.67	8.86	9.27
Lube Oils	16.67	16.70	17.59
Crude	2.81	2.81	2.83

REFINERY YIELDS

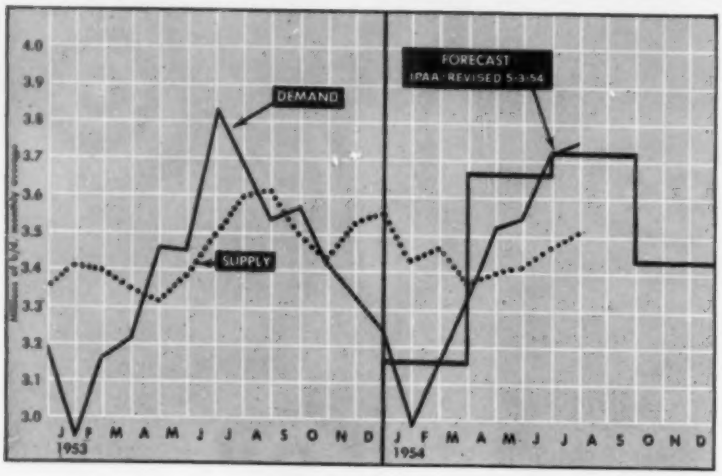
% on Crude Runs to Stills

	July 1954*	June 1954	July 1953
Gasoline	44.0	44.1	44.6
Kerosine	4.6	4.2	4.2
Distillates	19.7	20.0	20.0
Residuals	16.3	16.7	17.1

*Through July 16.

SOURCE OF DATA (except prices): May, June and July, API weekly reports; earlier months, Bureau of Mines.

Gasoline Output Continues Less Than in 1953

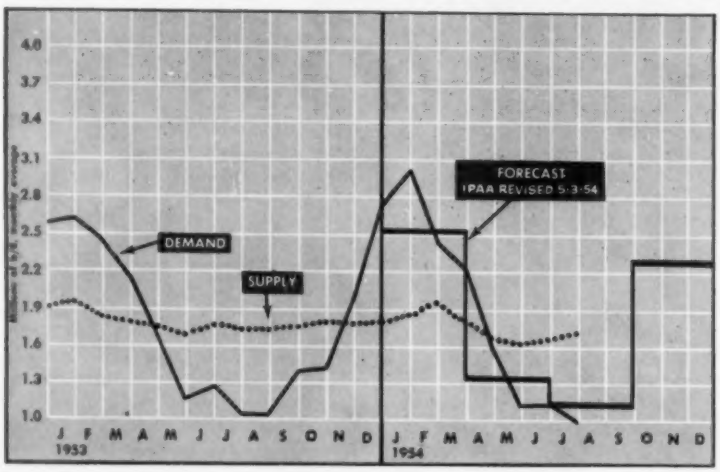


MOTOR FUEL

	From Crude	From Nat. Gas	Total
SUPPLY (Millions of b/d)			
July '54*	3.097	.420	3.517
July '53	3.195	.405	3.600
Change	—.098	+.015	—.083
% Change	3.1	3.7	2.3
DEMAND (including Exports) (Millions of b/d)			
July '54*			3.754
July '53			3.691
Change			+.063
% Change			1.7
TOTAL SUPPLY (Millions of bbls.)			
6 Mos. '54	547.948	73.005	620.953
6 Mos. '53	547.044	68.387	615.431
Change	+.904	+4.618	+5.522
% Change	0.2	6.8	0.9
TOTAL DEMAND (including exports) (Millions of bbls.)			
6 Mos. '54			613.319
6 Mos. '53			605.648
Change			+7.671
% Change			1.3

*Through July 16

Heating Oil Demand Drops Under 1,000,000 b/d

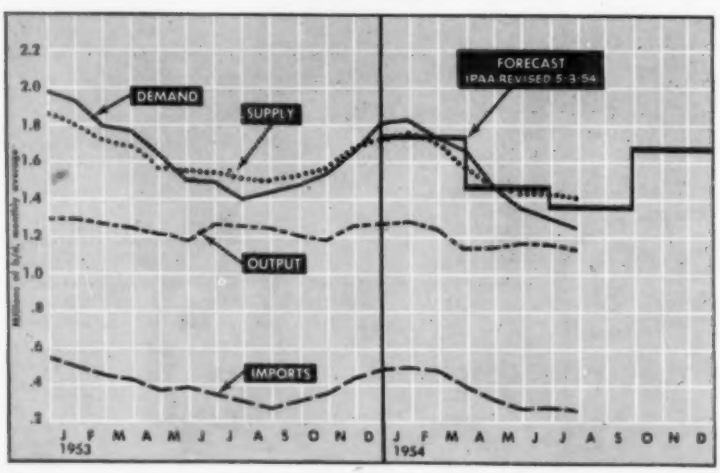


HEATING OILS

	Kerosine	Dist. Fuels	Total
PRODUCTION (Millions of b/d)			
July '54*	.325	1.389	1.714
July '53	.302	1.434	1.736
Change	+.023	—.045	—.022
% Change	7.6	3.1	1.3
DEMAND (Including Exports) (Millions of b/d)			
July '54*	.159	.820	.979
July '53	.187	.872	1.059
Change	—.028	—.052	—.080
% Change	15.0	6.0	7.6
TOTAL PRODUCTION			
6 Mos. '54	62.101	258.014	320.115
6 Mos. '53	63.563	263.342	326.905
Change	—1.462	—5.328	—6.790
% Change	2.3	2.0	2.1
TOTAL DEMAND (including Exports) (Millions of bbls.)			
6 Mos. '54	63.142	285.873	349.015
6 Mos. '53	63.625	280.866	344.491
Change	—.483	+5.007	+4.524
% Change	0.8	1.8	1.3

*Through July 16

Residual Demand Lowest in Two Years



RESIDUAL FUELS

	Refinery Output	Imports	Total
SUPPLY (Millions of b/d)			
July '54*	1.146	.286	1.432
July '53	1.224	.288	1.512
Change	—.078	—.002	—.080
% Change	6.4	0.7	5.3
DEMAND (including Exports) (Millions of b/d)			
July '54*			1.258
July '53			1.408
Change			—.150
% Change			10.7
TOTAL PRODUCTION (Millions of bbls.)			
6 Mos. '54	215.623	68.350	283.973
6 Mos. '53	225.993	72.774	298.767
Change	—10.370	—4.424	—14.794
% Change	4.6	6.1	5.0
TOTAL DEMAND (Including Exports) (Millions of bbls.)			
6 Mos. '54			284.346
6 Mos. '53			306.526
Change			—22.180
% Change			7.2

*Through July 16

SOURCE OF DATA: May, June and July, API weekly reports; earlier months, Bureau of Mines.

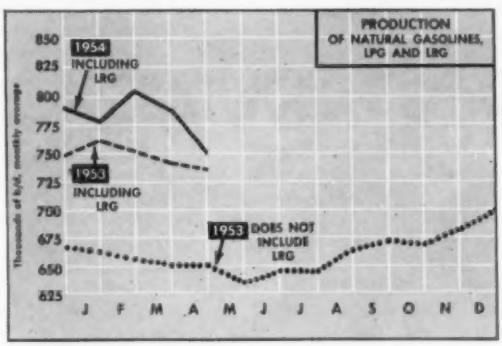
RUNS TO STILLS and DISTRIBUTION OF PRIMARY STOCKS BY U.S. REFINERY DISTRICTS

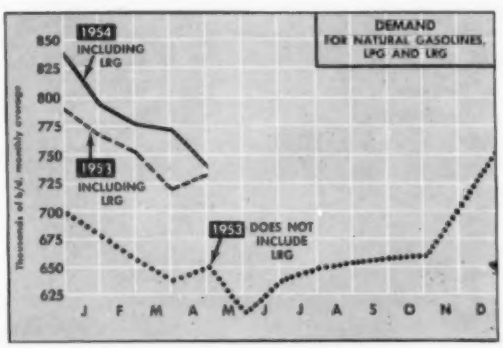
(Primary stocks include those at refineries, at large terminals and in pipelines; current data based on API reports; 1953 Crude Runs data, API reports; 1953 stocks data, Bureau of Mines reports)

Districts	RUNS TO STILLS (Millions of b/d average for week ending on date shown) July 16 1954	July 17 1953	Change	% Change	GASOLINE STOCKS (Millions of bbls., end of month) June 1954	June 1953	Change	% Change	RESIDUAL STOCKS (Millions of bbls., end of month) June 1954	June 1953	Change	% Change
East Coast	1.092	1.101	— .009	0.8	37.074	33.160	+ 3.914	11.8	10.027	10.806	— .779	7.2
Gulf Coast	2.163	2.221	— .058	2.6	23.741	27.416	+ 1.325	4.8	6.039	7.708	—1.669	21.7
Total Coastal	3.255	3.322	— .067	2.0	65.815	60.576	+ 5.239	8.6	16.066	18.514	—2.448	13.2
Appalachian	.183	.199	— .011	5.5	6.912	5.146	+ 1.766	34.3	.851	.675	+ .176	26.1
Ind.-Ill.-Ky.	1.294	1.278	+ .016	1.3	36.888	28.951	+ 7.937	27.4	4.614	3.717	+ .897	24.1
Okla.-Kans.-Mo.	.627	.596	+ .031	5.2	17.050	15.168	+ 1.882	12.4	1.372	1.090	+ .282	25.9
Other Inland	.594	.617	— .023	3.7	18.349	15.006	+ 3.343	22.3	2.299	2.594	— .295	11.4
Total Inland	2.703	2.690	+ .013	0.5	79.199	64.271	+14.928	23.2	9.136	8.076	+1.060	13.1
Total East of Calif.	5.958	6.012	— .054	0.9	145.014	124.847	+20.167	16.2	25.202	26.590	—1.388	5.2
California	1.011	1.076	— .065	6.0	20.526	20.035	+ .491	2.5	25.362	17.211	+8.151	47.4
Total U.S.	6.969	7.088	— .119	1.7	165.540	144.882	+20.658	14.3	50.564	43.801	+6.763	15.4

Districts	DISTILLATE STOCKS (Millions of bbls., end of month) June 1954	June 1953	Change	% Change	KEROSINE STOCKS (Millions of bbls., end of month) June 1954	June 1953	Change	% Change	HEATING OIL STOCKS (Millions of bbls., end of month) June 1954	June 1953	Change	% Change
East Coast	28.126	26.425	+1.701	6.4	11.474	10.912	+.562	5.2	39.600	37.337	+2.263	6.1
Gulf Coast	13.395	18.094	—4.699	26.0	5.692	6.088	—.396	6.5	19.087	24.182	—5.095	21.1
Total Coastal	41.521	44.519	—2.998	6.7	17.166	17.000	+.166	1.0	58.687	61.519	—2.832	4.6
Appalachian	2.158	1.463	+ .695	47.6	.845	.967	—.122	12.6	3.003	2.430	+ .573	23.6
Ind.-Ill.-Ky.	16.394	13.532	+2.862	21.1	6.146	5.628	+.518	9.2	22.540	19.160	+3.380	17.6
Okla.-Kans.-Mo.	9.586	9.321	+ .265	2.8	1.603	1.756	—.153	8.7	11.189	11.077	+ .112	1.0
Other Inland	4.770	4.551	+ .219	4.8	1.447	1.405	+.042	3.0	6.217	5.956	+ .261	4.4
Total Inland	32.908	28.867	+4.041	14.0	10.041	9.756	+.285	2.9	42.949	38.623	+4.326	11.2
Total East of Calif.	74.429	73.386	+1.043	1.4	27.207	26.756	+.451	1.7	101.636	100.142	+1.494	1.5
California	11.264	10.621	+ .643	6.1	.448	.399	+.049	12.3	11.712	11.020	+ .692	6.3
Total U.S.	85.693	84.007	+1.686	2.0	27.655	27.155	+.500	1.8	113.348	111.162	+2.186	1.9

Natural Gas and Refinery Gas Liquids





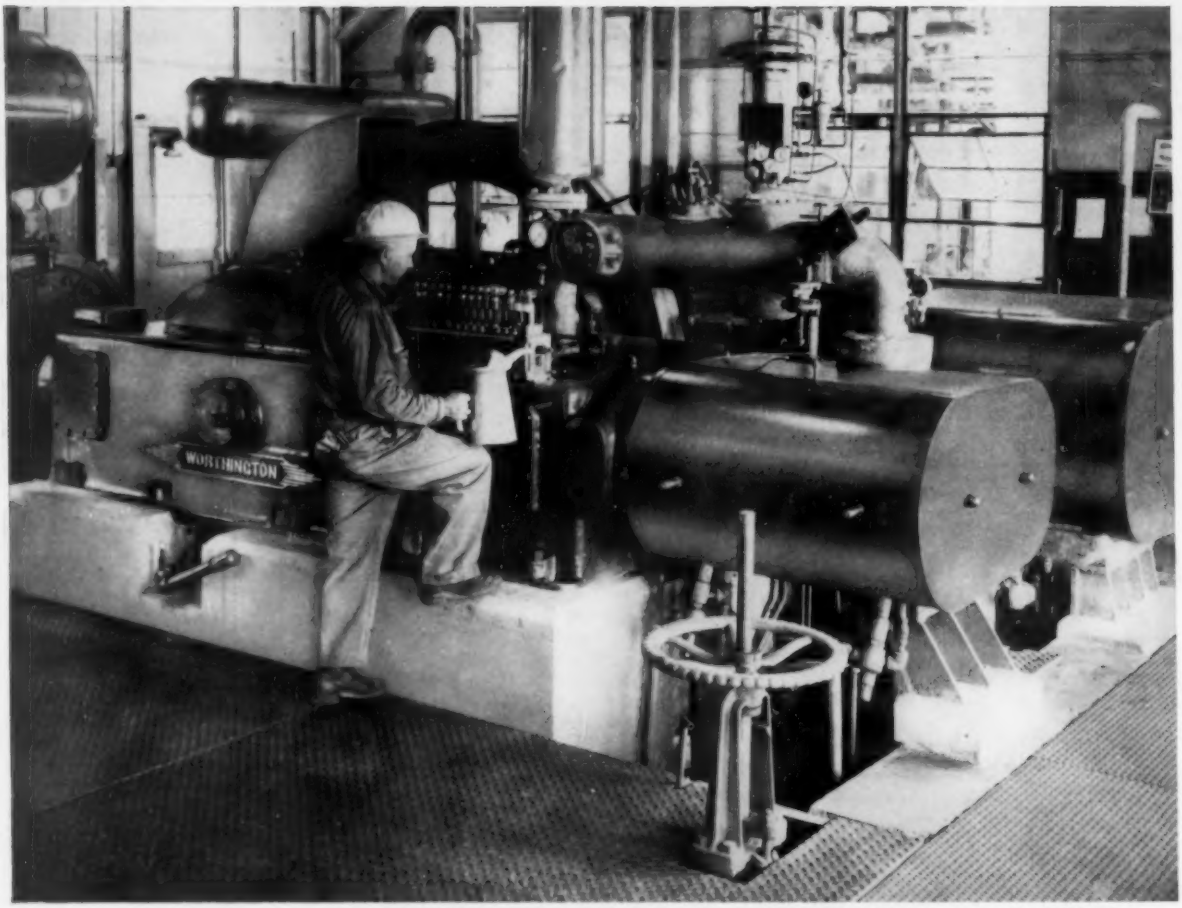
SUPPLY AND DEMAND STATISTICS

(Bureau of Mines Data)

CURRENT PRODUCTION (1000 b/d monthly average)	Apr. 1954	Mar. 1954	Apr. 1953
At Natural Gasoline and Cycling Plants			
Liquefied Petroleum Gas	313	332	308
Natural Gasoline and Isopentane	263	265	247
Condensate	31	30	26
Finished Gasoline, Naphtha and Others	54	55	70
Total Natural Gasoline and Cycling Plant Production	661	682	651
Liquefied Refinery Gases	89	105	92
Total Marketable Gas Liquids	750	787	743
Lease Condensate	105	107	96
Total Natural Gas Liquids	855	894	839
CURRENT DEMAND (1000 b/d monthly average)			
LPG and LRG	380	418	390
Natural Gasoline, Isopentane and Others	358	353	343
Total Current Demand	738	771	733

	Apr. 1954	Apr. 1953
CUMULATIVE PRODUCTION (1000 bbls.)		
LPG and LRG	52,245	48,808
Natural Gasoline, Isopentane and Others	41,390	41,307
Total Marketable Gas Liquids	93,635	90,115
CUMULATIVE DEMAND (1000 bbls.)		
LPG and LRG	50,780	48,093
Natural Gasoline, Isopentane and Others	41,749	41,015
Total Cumulative Demand	92,529	89,108

STOCKS (1000 bbls., end of Month)	Apr. 1954	Mar. 1954	Apr. 1953
LPG and LRG	5,942	5,260	2,789
Natural Gasoline, Isopentane and Others	4,529	4,832	4,580
Total Stocks	10,471	10,092	7,369



AVAILABLE STEAM DRIVES THIS WORTHINGTON COMPRESSOR at the Rock Island Refining Company in Indianapolis. Part of the hydrocarbon gas being compressed is taken off between compression stages and used to move a catalyst from storage.

Power failure won't stop this compressor

It's a Worthington *steam-driven* compressor which supplements a motor-driven compressor at the Rock Island Refining Company's plant in Indianapolis.

Here's the way Rock Island works it: the motor-driven machine (also a Worthington) is operated as a base load unit. The steam-driven compressor floats on the line, handling any swings in capacity by an increase or decrease in speed. And it's easy to vary the speed — and hence the capacity — by simply turning hand-wheels which control the amount of steam admitted to the compressor. If electrical power fails, the steam-driven unit can take over the entire compression job almost immediately. Result — process keeps going.

Five years of almost continuous operation have shown that the addition of the steam-driven Worthington was a wise move. One of the many features responsible for the fine performance record of this sturdy compressor is the exclusive Worthington Feather* Valve — the lightest, tightest, most efficient valve made. It's standard equipment on every Worthington compressor.

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CHEMICAL PROCESS NEWS

PUBLISHED BY CHEMICAL PROCESS DIVISION, THE M. W. KELLOGG COMPANY — AUGUST 1954

NOTES ON SYNTHOL

Synthol is the name of the Kellogg-developed process for catalytically reacting synthesis gas (carbon monoxide and hydrogen) to produce a wide variety of hydrocarbon materials and chemicals. Synthesis gas for the process can be derived from either natural gas or coal.

* * *

The first plant to utilize Synthol on a commercial scale is now under construction by Kellogg in South Africa. Partial combustion of coal (from vast deposits near the plant site) will form the source of the synthesis gas; primary products of the plant will be "petroleum" fuels—around 60 million gallons per year, of which the major part will be motor gasoline.

* * *

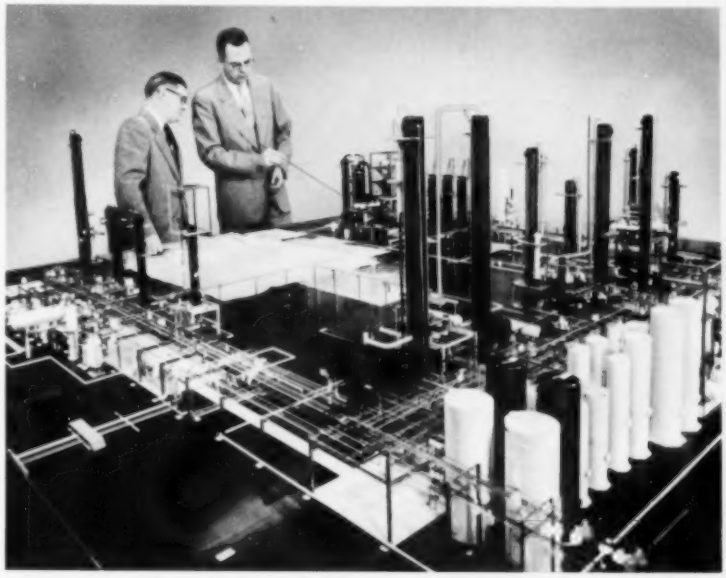
In addition to gasoline and fuel oil, the plant's output will include an impressive quantity of industrial and agricultural chemicals—about 125 million pounds. Many of these are oxygenated compounds, produced as by-products in the Synthol unit. While their volume is small in comparison with the enormous amounts of fuels produced, the higher market value of these chemicals adds substantially to the over-all attractiveness of the Synthol process.

* * *

The water-soluble or chemical stream from the Synthol unit is passed through a series of operations involving both extractive and conventional distillation to separate methanol, anhydrous ethanol, methyl ethyl ketone, and acetone. The methanol will be used as a solvent in the process and the ethanol will be blended into the gasoline pool. The other two chemicals will be marketed.

* * *

Additional equipment is being installed to produce commercial grade propanol and/or butanol, or to further process these products as additional gasoline.



Low Production Costs, High Yields and Flexible Operation Characterize New Phenol-from-Cumene Process

Shown above is a detailed model of a unique chemical plant Kellogg is currently building for Hercules Powder Company at Gibbstown, N. J. The plant will produce phenol, acetone, and methyl styrene, using the Hercules-Distillers process for oxidizing and splitting cumene. Kellogg, which developed the mechanical design of the commercial process in collaboration with Hercules, is also the originator of the process to be used for making the cumene feed.

The over-all process offers an unusual example of how refinery products can be upgraded to industrial chemicals to obtain a radical increase in value. Propylene, for example, which makes up one-third the volume of the initial feedstock, is readily available at low-cost. It can be combined with benzene by alkylation to form cumene, which is then oxidized to cumene hydroperoxide. The latter is subsequently split in a cleavage reaction to form the final products.

Of these, the phenol portion of the output is derived from the benzene part of the initial input. In the same way, the acetone produced is attributable to the low-cost propylene third of the feed.

As compared with other processes, the latter product—acetone—at present prices provides a bonus for the phenol produced as a major product. Moreover, the comparatively small quantity of methyl styrene produced can be separated and sold for use in the plastics industry, or it can be easily converted back to cumene and re-used in the process.

Recently completed phenol-from-cumene plant in Canada.

(continued on following page)

CONTINUED FROM PRECEDING PAGE

ETHYLENE PROPYLENE BUTYLENE

METHANOL ETHANOL PROPANOL

BUTANOL ISO OCTYL ALCOHOL

BENZENE XYLENE TOLUENE

PHENOL FROM CUMENE

AMMONIA UREA

GLYCERIDES

Kellogg to Build Second Ethylene Plant for British Producer

Engineering is now virtually complete and construction is scheduled to begin shortly on the second ethylene plant to be designed and built by Kellogg for an important producer of chemicals in the British Isles. With a similar plant which is now under construction in Italy, the new one brings to a total of three the number of plants utilizing Kellogg's unique process for the steam-cracking of petroleum fractions to make olefins.

As embodied in these plants, Kellogg's process is characterized by high yields of high purity ethylene, and by high conversion of the feed without coking of furnace tubes. The prototype plant has now been in operation in England for more than two years and at no time has a shutdown been caused by furnace coking.

In essence, the process consists of a special high-temperature pyrolysis section in which naphtha or gas oil vapors are broken down, in the presence of steam, into ethylene and other gaseous fractions. These are then separated in a special low temperature fractionation system developed by Kellogg which allows production of ethylene of the extremely high purity needed for polyethylene manufacture. The process has demonstrated a high flexibility in both the handling of various feedstocks and in the ratios of desired products (olefins and aromatics) in the output.

The new plant, while not a duplicate of its predecessor, will preserve the general over-all features of the first plant but will include some additional process improvements. It will be slightly larger, and, like the first plant, will crack heavy naphtha for the primary production of ethylene to be used for manufacturing polyethylene.

(continued from previous page)

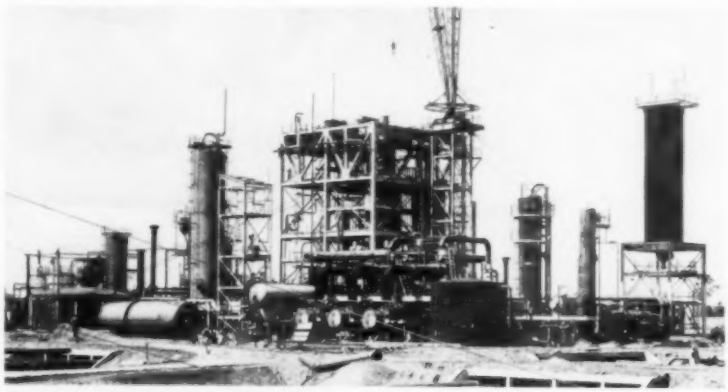
Low Production Costs..

In addition to these valuable economic considerations, the process requires comparatively low initial investment and operating expense. High pressures or temperatures are not used and consumption of chemicals such as alkalis and acids is comparatively low.

Work Progresses on Sasol Plant

Shown here are two major sections of the multi-million-dollar synthesis project now under construction by Kellogg in South Africa. While the primary purpose of the plant is to synthesize gasoline and other oil products from coal, it will also produce large volumes of valuable chemicals which will be purified in Kellogg-designed equipment. (Photo above shows fractionation equipment for both oil products and chemicals.)

Shown (below) well underway is the most important unit in the process sequence. This is the Kellogg Synthol unit which will catalytically convert synthesis gas to liquid hydrocarbon and chemical products. (See preceding page for further details on Kellogg's Synthol Process.)



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For steam, air, gas, oil, water or other fluid. Sizes ¼", ⅜", ½", ¾", 1". Outlet pressures from 2 to 30 psi; 15 to 150 psi. Easily installed—no external control lines.
Bulletin C-95 illustrates and describes new internal construction features which give higher capacity and close regulation. Write for your copy today.
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an example of WOLVERINE condenser tube convenience

THE STORY OF WOLVERINE

U-BEND PALLET

Have you tried Wolverine's convenient method of palletizing either plain or finned U-bend condenser tubes? Here's the story: Wolverine manufactures top-quality condenser tubes and uses your prints to arrange them in the exact order of installation for your heat exchanger units. All you have to do when retubing is to place the disposable box-type pallet in front of the heat exchanger and feed directly from it to the unit. You save on handling, storage, inventorying. U-bend condenser tubes eliminate one header sheet and reduce rolling in operations by one half.

an example of WOLVERINE condenser tube convenience

THE STORY OF WOLVERINE

FINNED CONDENSER TUBE

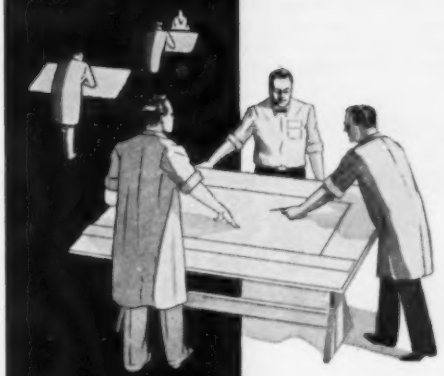
Here's how to get more BTU's per foot of condenser tube. It's Wolverine Trufin*. Its fins are an integral part of the tube—they're extruded—literally squeezed—from the tube wall. That means they'll stand up under the shock of vibration and the effect of sudden temperature changes. Trufin gives you maximum heat transfer—and can be bent or coiled just like prime surface tube. And for added convenience, Trufin is available in four different end finishes: both ends plain, both stripped, both finned, or one stripped and the other plain. Wolverine also produces prime surface condenser tubes.

*REGISTERED U.S. PATENT OFFICE.

an example of WOLVERINE condenser tube convenience

THE STORY OF WOLVERINE

PRIME SURFACE CONDENSER TUBE

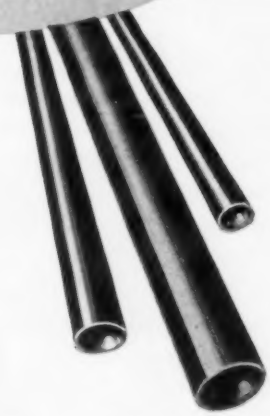


Naturally, some heat exchanger jobs are most economically handled by Wolverine prime surface tubing. To make it easy to pick the right metal for the application, Wolverine produces prime surface tubing in a wide variety of alloys and sizes. For example, you can select from copper; Admiralty and inhibited Admiralty; cupro nickel 70-30, 80-20, 90-10; aluminum brass, red brass 85%; and Muntz metal.

an example of WOLVERINE condenser tube convenience

THE STORY OF WOLVERINE

ONE-SOURCE CONVENIENCE



In addition to the wide variety of copper-base alloys available, Wolverine produces prime surface and finned condenser tube in aluminum and electric-welded steel. Wolverine's Field Engineering Service is on tap to give you quick answers to problem dealing with alloys, corrosion, heat transfer, and so on. It all adds up to Tubemanship and convenience with a capital "C"! You'll find the whole story in Wolverine's condenser and heat exchanger booklet. Write for our Condenser Book—today. WOLVERINE TUBE, Division of Calumet & Hecla, Inc., 1441 Central Avenue, Detroit 9, Michigan.

Wolverine Trufin available in Canada through the Unifin Tube Company, London, Ontario.

WOLVERINE TUBE

DIVISION OF CALUMET & HECLA, INC.

Manufacturers of Quality-Controlled Tubing

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES

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PHYSICS . . In one easy lesson or why *LEVERAGE* is a good invention

Reprinted from the No. 3, 1948, issue of the Armstrong Trap Magazine

A BURLY giant, whom we shall call Dullbottom for lack of a more descriptive name, was amusing himself in the Petrified Forest one warm July afternoon. Entranced by the many colorful and giant-sized playthings there, he was happily engaged in rolling petrified logs down a small incline when one toppled onto his toe. Despite his most persistent efforts he was unable to dislodge this log, later calculated by Unimpeachable Authorities to weigh 1,000 lbs.

Dullbottom's gruntings and groanings attracted a petite and pretty Physics teacher who (fortunately for our story) was strolling in the vicinity. It took her but a glance to grasp the situation and, without hesitation, she obtained a crowbar from a convenient source of supply, applied LEVERAGE to the log and freed the giant's giant toe.

Completely befuddled by the powers of his 90 lb. benefactor, but clumsily grateful, he asked to feel her muscle, a request which was instantly refused. Instead, the young lady offered to explain the fundamentals of LEVERAGE. Delighted by her explanation, that given sufficient LEVERAGE, she could move any weight, Dullbottom immediately proceeded to roll a 4,000 lb. petrified log onto his other foot.

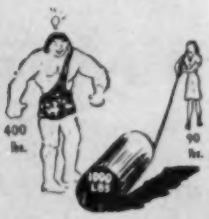
With the infinite patience acquired from dealing with adolescents in the classroom, our pretty Miss obligingly procured another crowbar four times as long as the first and proceeded to move the weight—BUT, much to the dismay of Dullbottom, only ¼ as far, which was, sad to relate, not far enough to free his toe.

And, thereby, hangs a tale. Let's use this little flight of fantasy to explain a fundamental reason why Armstrong steam traps have such large capacity for their size. Please refer to diagrams on the blackboard.

ARMSTRONG MACHINE WORKS
826 Maple Street
Three Rivers, Michigan

The Fairy Story

1. All Brawn . . . No Brains



2. Science to the Rescue

3. Stupidity Triumphant

No Leverage

To open a 1-1/16" orifice at 15 psi, a steam trap without leverage would require a bucket weighing 19-1/2 lbs. and displacing 29-1/4 lbs. of water. A trap big enough to hold this bucket would weigh somewhere neat 300 lbs. At 250 psi, the largest orifice this trap could open would be 9/32".

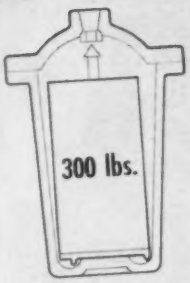
Correct Leverage

Contrast the No-Lever Trap with an Armstrong No. 216 weighing about 1/4 as much . . . 80 lbs. It also opens a 1-1/16" orifice at 15 psi and will open a 3/8" orifice wide at 250 psi — nearly 80% greater than that of the No-Lever Trap. Result of CORRECT LEVERAGE: less weight, less radiation, lower price trap, less installation cost, greater capacity.

Too Much Leverage

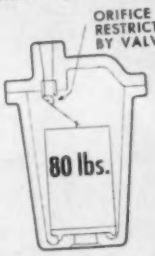
Here's an 80 lb. trap with leverage double that of the No. 216 Armstrong described above. It will open an appreciably larger orifice at any given pressure than the standard Armstrong No. 216. *But, it won't open the valve wide!* There isn't room to get the valve completely away from its seat. Flow through the orifice is thereby restricted and capacity is reduced below that of the No. 216. The larger orifice and the greater leverage is a total loss! To get the valve wide open would require a bigger trap.

The Real Thing



Get Results . . . But Impractical

Efficiency, Economy



Misapplied Science

Send for Catalog

Size for Size, Armstrongs have greater capacity because the correct application of high leverage permits the full opening of a large orifice!

ARMSTRONG STEAM TRAPS

Chitwood Gasoline Plant of Magnolia Petroleum Company, near Rush Springs, Oklahoma. Painting Contractor: Construction Service Company. Aluminum Paint: Socony-Vacuum #20-A-9.

ALUMINUM PAINT at Magnolia Petroleum Company improves appearance, is easy to apply, lasts longer than other paints

We asked Magnolia why they use aluminum paint. They said that aluminum paint improves appearance and that it is easily applied. Furthermore, aluminum paint has excellent qualities of durability.

Magnolia's experience demonstrates why aluminum paint has become the most practical . . . most popular paint in the petroleum industry. In addition, the excellent reflective qualities of aluminum paint on storage tanks and towers reduce interior temperatures . . . cut evaporation losses. So it's really a matter of economy—and that's important to every business.

ALCOA does not make paint . . . but ALCOA Aluminum Pigments are used in *more* aluminum paints than any other brand. ALCOA's co-operation with paint manufacturers has made possible many special formulas designed to solve your toughest problems. Aluminum paint offers the utmost in brightness and protection.

Write us about your paint problems. Mail the coupon today. *Free booklet* tells how to paint with aluminum.

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Aluminum Company of America, Paint Service Bureau
1792-H Alcoa Building, Pittsburgh 19, Pa.

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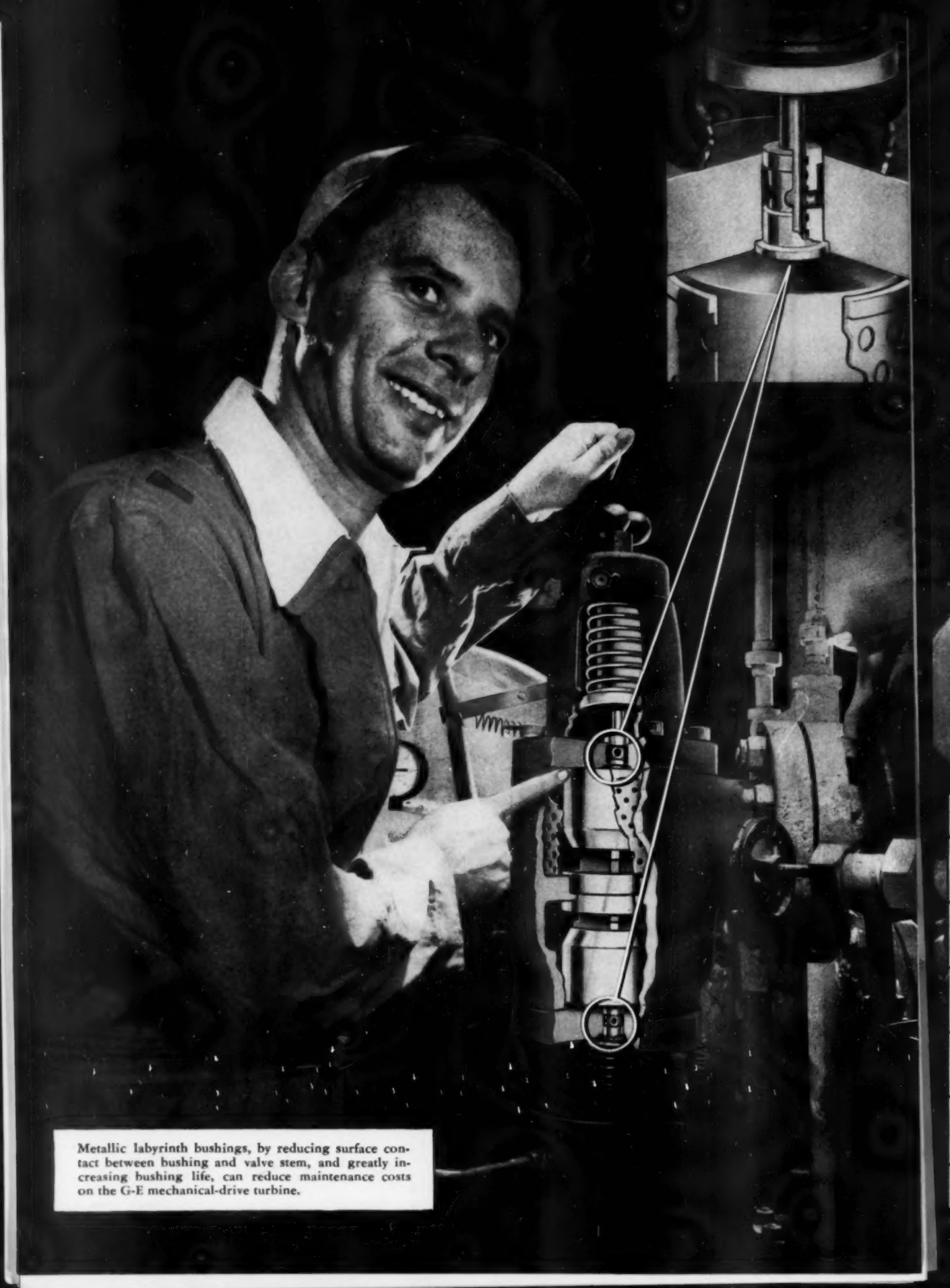


Metallic labyrinth bushings, by reducing surface contact between bushing and valve stem, and greatly increasing bushing life, can reduce maintenance costs on the G-E mechanical-drive turbine.

ANOTHER PLUS VALUE OF G-E MECHANICAL-DRIVE TURBINES...

Metallic Labyrinth Bushings Cut Turbine Maintenance Costs

Using metallic labyrinth bushings instead of soft packing on the throttle valve stem and operating valve stem of General Electric's Type DP mechanical-drive turbine has several important advantages. Corrosive attacks on the valve stems, often caused by soft packings, are prevented.

Because surface contact between bushing and valve stem is reduced to a minimum, friction is practically eliminated—bushing life is increased tremendously. This feature alone can save you up to $50.00 in direct maintenance costs—plus the expense of down-time caused by frequent packing replacements.

HERE'S ANOTHER ADVANTAGE. Since frictional drag on the governing system is reduced to a minimum, you get more accurate, sensitive, reliable governing with G.E.'s Type DP turbine.

Metallic labyrinth bushings make an effective steam seal by means of grooves in the bushing which throttle pressure and minimize any steam leakage (see illustration).

THESE METALLIC LABYRINTH BUSHINGS are just one of many DP features which save you money throughout total turbine life. The chart below indicates other areas of savings.

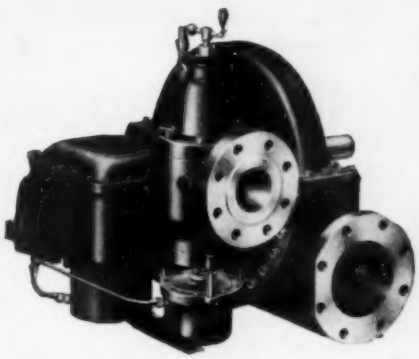
Remember—the total cost is often more than just the sales price. But G.E.'s standard DP turbines include the extra features that save you extra costs. For more information contact your nearest G-E apparatus sales office. Write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." General Electric, Schenectady 5, N.Y.

252-66

GENERAL ELECTRIC

INSTALLATION AND MAINTENANCE COST-SAVING FEATURES

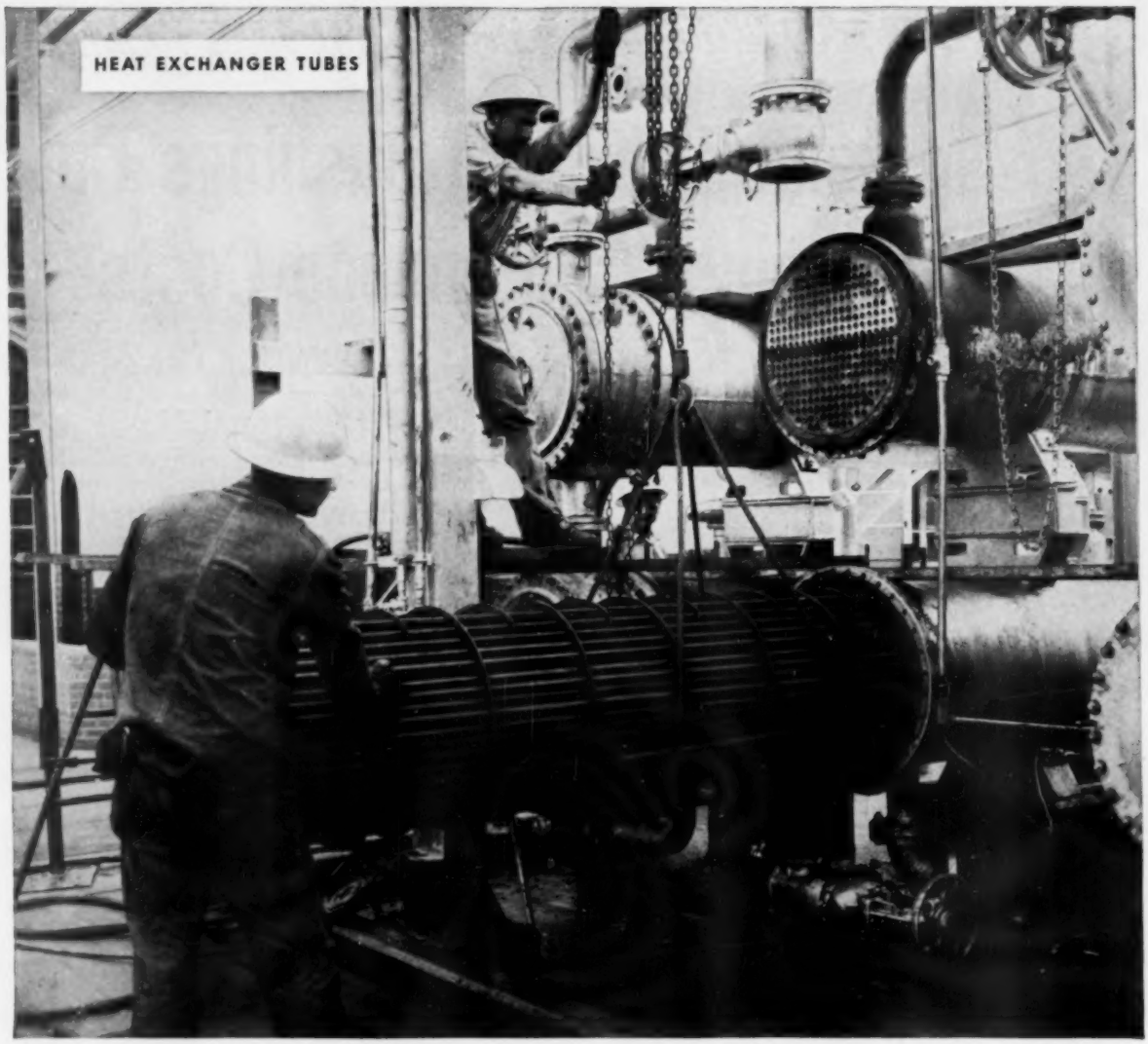
THESE EXTRA FEATURES, STANDARD ON ALL G-E TYPE DP TURBINES, CAN . . .	Save You up to
COMBINED TRIP-THROTTLE VALVE Eliminate extra cost of buying and installing valve ahead of the turbine.	$200.00
SINGLE RESERVOIR FOR COOLING LUBE OIL Eliminate extra cost of piping cooling water to and between bearings.	50.00
MAJORITY OF PARTS INTERCHANGEABLE One set of spare parts protects several units—less money tied up in inventory.	100.00
METALLIC-LABYRINTH VALVE STEM BUSHING Eliminate labor costs of replacing soft packings; cut down-time production losses.	50.00
SHAFT MONEL-SPRAYED AT PACKING FIT Saves frequent cost of purchasing and installing carbon rings; contributes to long shaft and packing life.	20.00
ESTIMATED TOTAL SAVINGS	$420.00



G-E Type DP Mechanical-drive Turbine

COMPARE THE FEATURES
EVALUATE ALL THE COSTS

See why G-E Standard Type DP turbines are your most economical buy.



PERFORMANCE RECORD of these tubes under actual operating conditions is now a part of Anaconda's extensive collection of case histories.

Use of Anaconda Cupro Nickel, 10%-755 Tubes in Texas refinery may answer your tube problem

Imagine a collection of tube performance case histories that can answer many of the corrosion problems you face!

Our files bulge with such a collection. Here is experience accumulated over almost a century. Here are detailed records of tube performance under hundreds of actual operating conditions.

We can put the information in these files to work for you at once—to help you select the one best alloy for your job.

Here's a case history we are now adding—the use of ANACONDA Cupro Nickel, 10%-755* Tubes in the Port Neches Refinery of a major oil producer.

These tubes—in use two years—cool heavy gas oil in an Alco Exchanger on a Crude Pipe Still Unit. Gas oil at about 500°F.—mildly corrosive—comes in contact with the outside of these tubes. Brackish river water—with a high salt content—circulates through the tubes. Yet the tubes show no sign of corrosion.

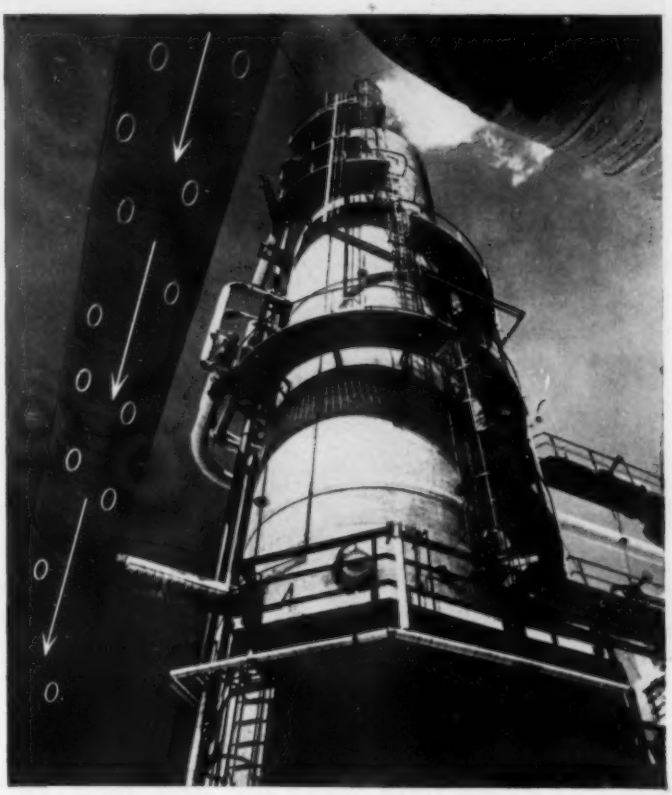
CUPRO NICKEL, 10%-755 resists corrosion almost as well as Cupro Nickel, 30%-702; yet it costs much less. Polluted sea water and sea water with entrained air—even at relatively high velocity—have little effect on this alloy.

Help for your tube problem. No one tube alloy serves best under all conditions. Your problem is one of choosing the right alloy for the job. Let Anaconda's Technical Department help you. Write, outlining your operating conditions, to Dept. TD, *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

*U.S. Patent No. 2,074,604 54109

ANACONDA®
Tubes and Plates
for Condensers and Heat Exchangers

NEUTRALIZE OIL ACIDS WITH LOW-COST *Anhydrous Ammonia*



Get dual protection from acid:—

- neutralize unwanted acid constituents in oil
- protect valuable, costly equipment and storage tanks from corrosive acid

One pound of Anhydrous Ammonia will render harmless the same quantity of acid as several pounds of other neutralizers—yet it is one of the lowest cost neutralizing agents delivered to the refinery.

Here's how our Anhydrous Ammonia saves equipment: Easily vaporized, the ammonia is introduced into the gas stream, neutralizing corrosive acids as soon as they form. Because it is highly soluble and has a high rate of diffusion in oil, it goes to work without forming water or undesirable emulsions. Once neutralized, unwanted products are easily eliminated from the oil while excess ammonia is removed by blowing the oil with air.

Simplicity, low cost and high protection make the Anhydrous Ammonia system a highly preferred way to eliminate harmful acids. Find out how you can enjoy these advantages. Use the convenient coupon.

Shipping: Cylinder Ammonia—fast delivery from coast-to-coast chain of distribution points. 150-, 100- and 50-lb. cylinders.

In Bulk—from Hopewell, Va., Omaha, Nebr., or South Point, Ohio in 10,000-gallon tank cars.

Order a trial shipment of this exceptionally pure Anhydrous Ammonia *today!*

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☐ Send me a copy of the "Guide for the use of Barrett® Brand Anhydrous Ammonia in Cylinders."

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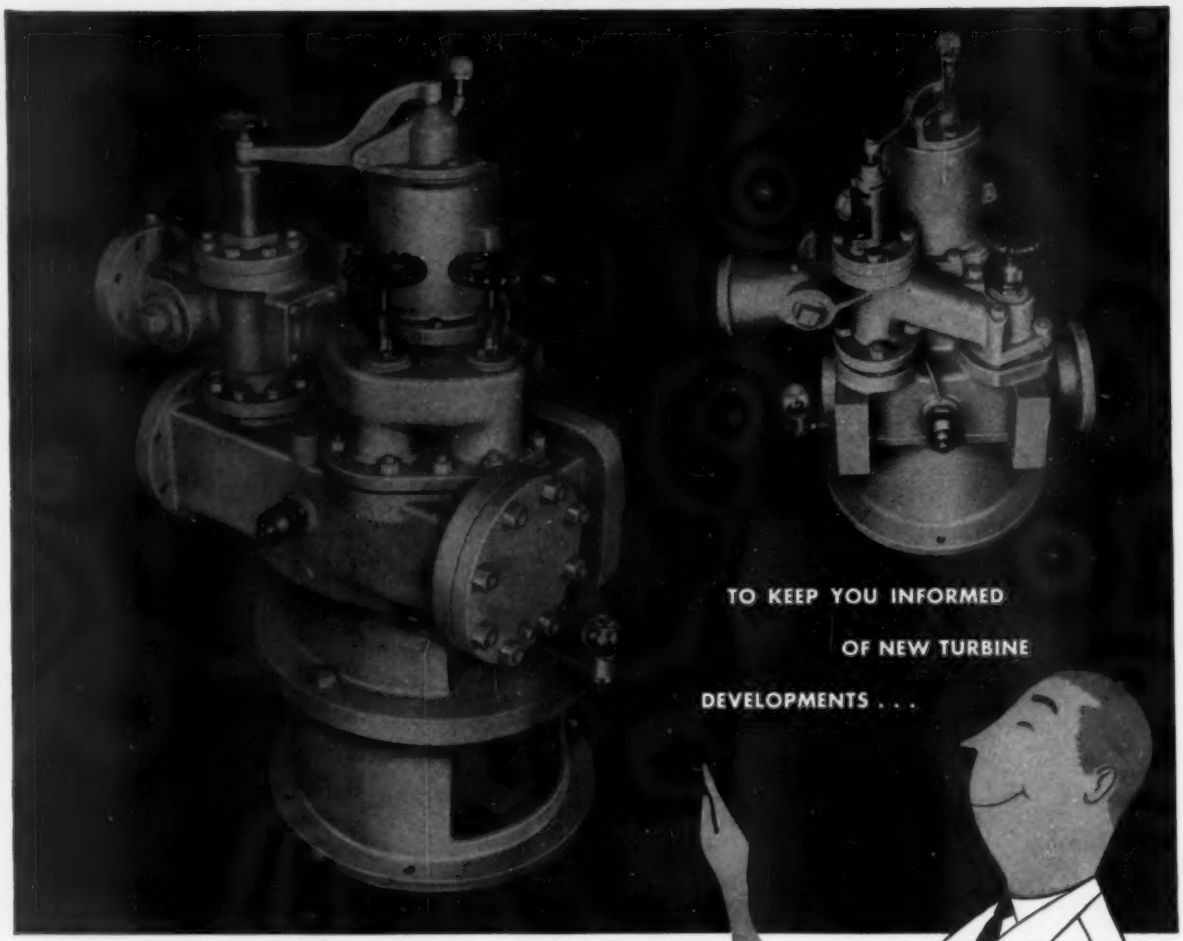

Here are a few of the many improved features which help make the new Dean Hill Vertical Turbines your best power-package buy:

1. **MORE POWER**—An added steam nozzle for Models DH-10V (new in vertical line) and DH-20V increased power *100%* over former one-nozzle counterparts. The DH-30V now has three steam nozzles and 50% more power.
2. **BETTER PERFORMANCE**—Two hand valves improve regulation of steam rate at reduced load. Improved packing boxes check steam pressure leakage and permit higher back pressures.
3. **LONGER SERVICE**—*Double-row* ball bearing has greater thrust capacity. Overlapping labyrinth slinger on lower bearing prevents moisture seepage.
4. **POSITIVE SAFETY**—Improved emergency trip mechanism has cylindrical guide to maintain alignment of trip valve stem in all positions.

MORE DETAILS?

You will want to study the other improvements in the DH Line . . . improvements made to increase the useful life and efficiency of the turbine without sacrificing the compactness and simplicity of design. Write now for our new Catalog No. 500, which includes full details on both Vertical and Horizontal DH Turbines.

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You can profitably use

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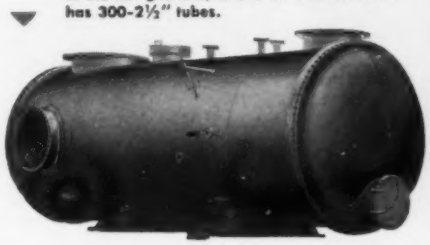
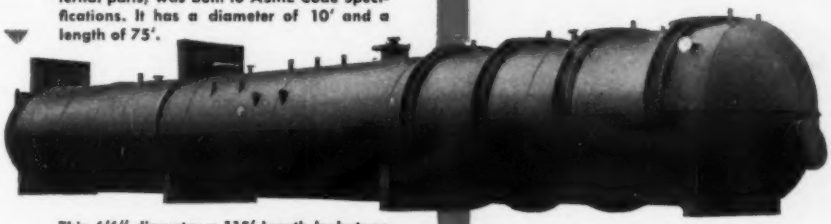
and facilities for PROCESSING EQUIPMENT

Here's a combination that can benefit any petro-chemical producer;—more than a century of manufacturing experience . . . plus unsurpassed facilities in three modern plants. In the production of petro-chemical equipment of all types, Struthers Wells has the facilities . . . the experience . . . the engineers and craftsmen to provide complete satisfaction on every job—large or small.

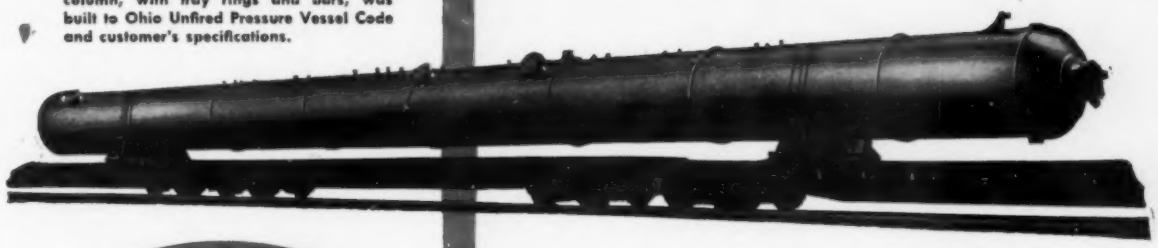
Waste Heat Boiler, complete with inlet and outlet heads. Designed for 275 pounds pressure, 1000° F. maximum temperature at the hot gas end, it is 8' in diameter and has 300-2½" tubes.



This Horizontal Reactor, complete with internal parts, was built to ASME Code Specifications. It has a diameter of 10' and a length of 75'.



This 6'6" diameter x 115' length isobutane column, with tray rings and bars, was built to Ohio Unfired Pressure Vessel Code and customer's specifications.



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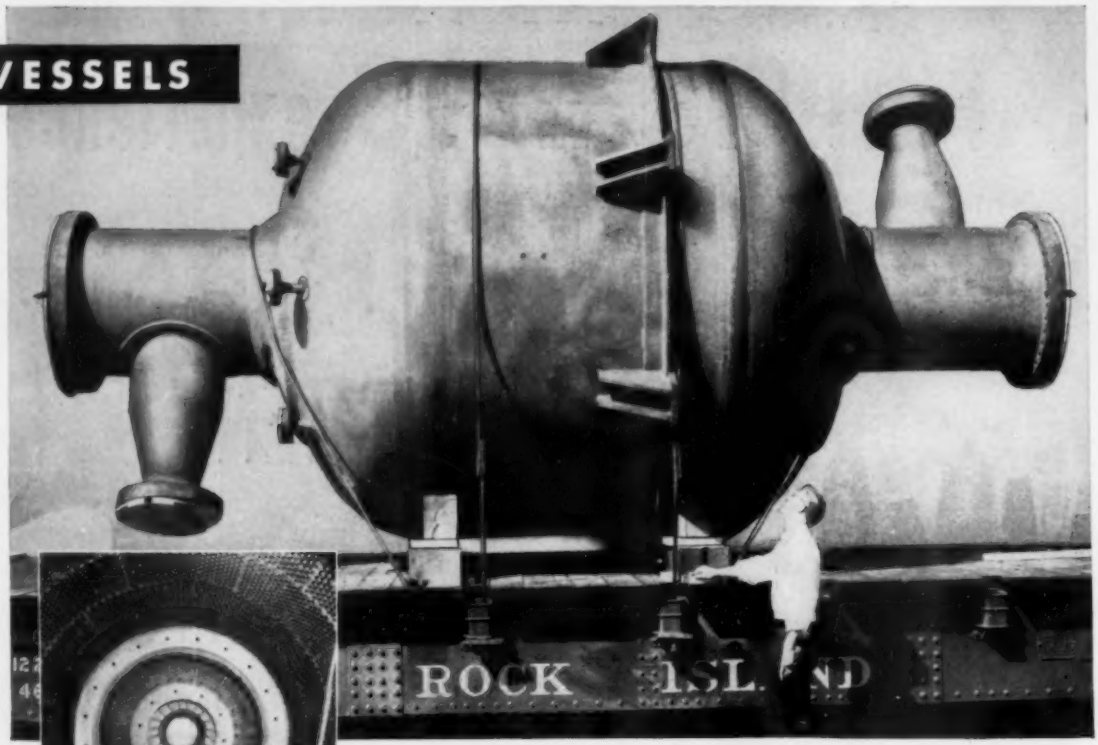
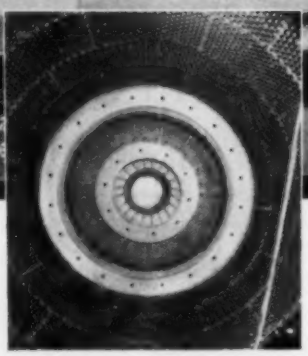
(*To obtain more data on advertised products see page 1260*)

A.O.Smith for

VESSELS



Refractory-lined reactor ready for shipment from the Milwaukee plant. Overall length, flange-face to flange-face: 21 ft. 7 in. Three of these A. O. Smith reactors, when installed, become the heart of a catalytic reforming plant.



These interior views show, *at top* expanded metal liner support prior to gunniting insulation. Grid platform support rings are visible. *Lower picture* shows shop-installed refractory lining covered by stainless steel lining designed with interlocking expansion joints.

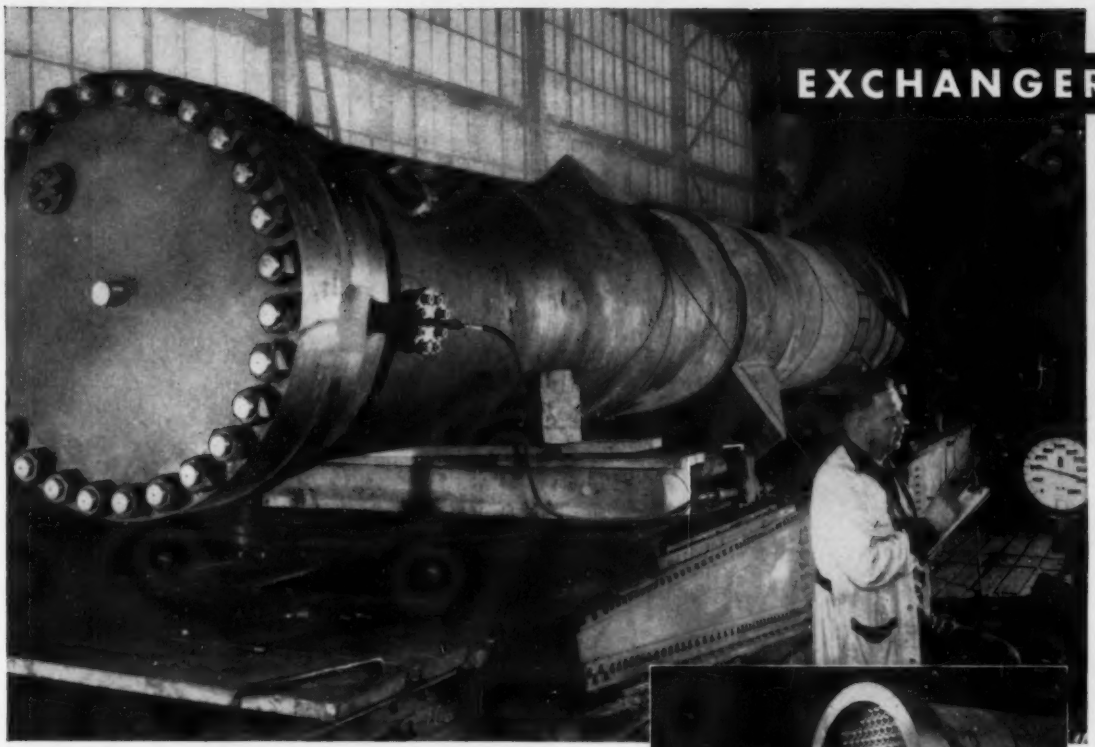
HIGH TEMPERATURE

A. O. Smith lined and

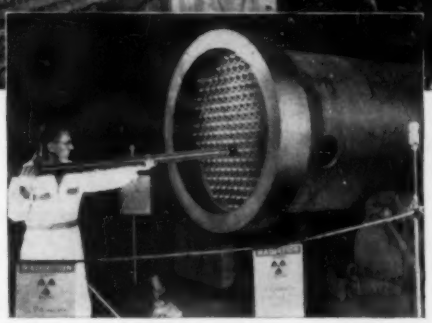
For thirty years, petroleum and chemical industries have come to us with pressure vessel and heat exchanger problems. Their reliance on the unmatched advantages we offer in manufacturing know-how and the resourcefulness of our research laboratories and technicians, design engineers and shop men has proved to be well placed. The two reactors shown here are examples of our work.

On this page is a special, refractory-lined vessel of A-212 steel, designed for 650 psi. and temperatures starting at 900° F. The walls are protected by shop-installed refractory lining. Total weight of 50 tons includes 28,000 lb. of lining, its supports

Outstanding Advantages



Shown here is one of twenty poly reactors going through our heat exchanger shop, undergoing tube side pressure test at 2160 psi. One-quarter inch wall tubes are welded to tube sheets and tubes rolled full depth on all poly reactors.



Radioactive cobalt being used for examination of welds during poly reactor construction. This method permits examining welds that are inaccessible to X-ray equipment.

HIGH PRESSURE

tubular reactors

and a catalyst grid platform on pedestal rings.

On this page is shown a poly reactor undergoing shop tests before shipment. Throughout fabrication and long before shop work begins, materials and processes are subjected to exhaustive tests to make sure quality demands are met. Metallurgical, spectrographic and pressure tests during and at completion of construction assure conformity to specifications.

YOU ARE INVITED

Whenever you have a pressure vessel or exchanger problem, write our Milwaukee office for information about the outstanding advantages which A. O. Smith research, engineering and construction offer.

Through research A.O. Smith *... a better way*

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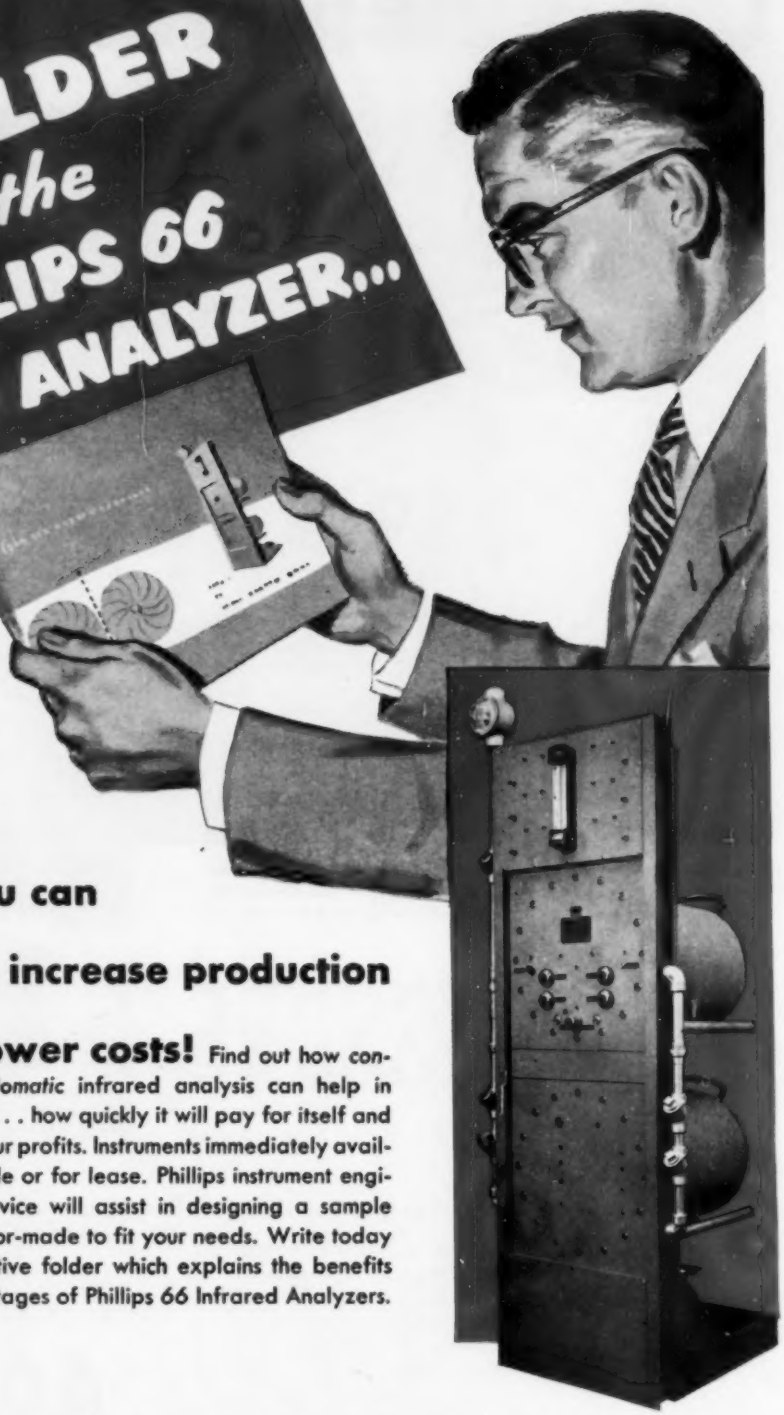

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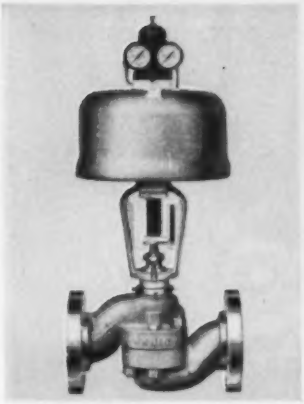

Model 1560

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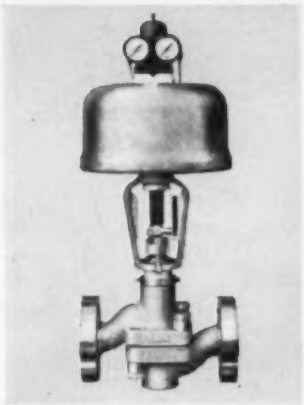

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BODY RATINGS – Standard 150, 300, 400, 600, 900, 1500, 2500 PSI. Others to 50,000 PSI.
BODY DESIGN – Globe, angle and three-way. Tight shut-off, single seat body. Free-flowing design eliminates erosion. Doolseal, Bellows seal, cooling fin interchangeable with standard bonnet. Optional Teflon guide bushings and Teflon seat seal.
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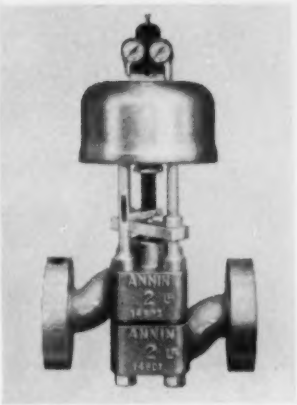

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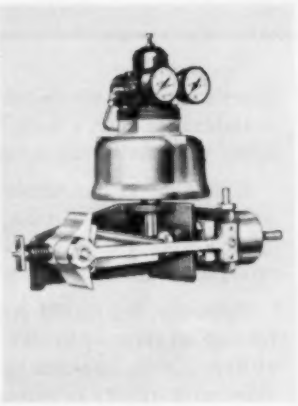

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Premier's new 3000 barrel
UOP Fluid Catalytic Cracker

(Advertisement)

New Cat Cracker Placed in Operation By Premier

By R. P. Hargis, President
Premier Oil Refining Company of Texas
Longview, Texas

PREMIER Oil Refining Company of Texas recently completed a multi-million dollar expansion program at Fort Worth, Texas, making our refinery there one of the most modern in the entire Southwestern area.

R. P. Hargis

The expansion program was rounded out April 10 when a 3,000 B/SD UOP Fluid Catalytic Cracking unit of the latest design went on stream. It is designed to crack blended atmospheric and vacuum gas oils at a conversion rate of 74 per cent into gasoline having 92 clear research octane rating.

Installation of the cat cracker, with its attendant new polymerization and gas concentration facilities—all three of which were designed and licensed by Universal Oil Products Company—brings to six the number of major processing units in operation at the Fort Worth refinery. Others are a UOP Platforming unit, which has a design capacity of 1,500 B/SD, a thermal cracker, and a crude unit. With these facilities, the Fort Worth refinery has now become self-sustaining. Its supply of crude oil is piped from the Ranger Field into Fort Worth.

Four Reasons for New Unit

Four major factors motivated our thinking about installing a cat cracker less than three years after the company built the UOP Platforming unit. These factors were, in brief:

1. A cat cracker would enable Premier to make greater amounts of high quality finished gasolines; it would open up new avenues for marketing such products as butane-butylene; it would put Premier in the position of converting excess middle distillates into marketable products.

2. It would provide not only the Fort Worth refinery but Premier's other Texas refineries at Arp, Baird and Longview with a choice gasoline blending stock having an F-1 leaded octane number of 98 to 100.

3. It would further improve the refinery's economic position by making possible a larger gasoline yield from the crude run. The overall gasoline yield at the Fort Worth refinery was 52 per cent. It was estimated that with a cat cracker a gasoline yield of 67 per cent could be obtained—an estimate that since has proved to be accurate.

4. A cat cracker would permit operating the refinery at its crude oil capacity of 7,500 B/CD.

Coincident with the unit going on stream, Premier launched an intensive newspaper, radio and TV advertising campaign to introduce its new "Ignition Controlled" ethyl gasoline and "Dynamic" regular gasoline. We are now producing a 95 octane premium gasoline and an 86 regular motor fuel to meet the ever-increasing demands for higher quality gasolines in our trade territory.

We supply approximately 100 independent jobbers and more than 600 retail outlets in an area extending from Shreveport, La., on the east to Abilene, Texas, on the west, and from the Red River on the north to the central portion of Texas on the south.

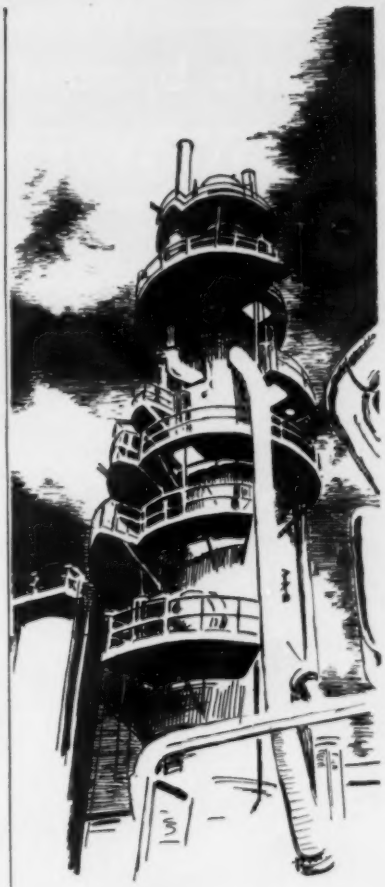
Octane Ratings Increased

Gasoline from the cat cracker is being transported to the Arp, Baird and Longview refineries for use as blending stock. This enables these plants to increase their octane ratings, and puts them in a more advantageous position to meet changing market conditions.

One of the unusual features of our new cat cracker is the placement of the reactor-regenerator on a structural steel skirt instead of having it mounted on a concrete base. Another interesting feature is the suspension of the air heater beneath the regenerator.

All of the pumps and the gas compressors are located under a reinforced concrete structure extending across the battery area parallel to the line of towers. Most of the heat exchangers, surge drums and receivers are placed on the roof of the concrete structure. This arrangement makes for compactness and maximum utilization of space, and enables our operators to control the unit with ease.

With the cat cracker now on stream, we are confident that the Fort Worth refinery is equipped to meet a wide variety of marketing conditions more profitably and with a greater degree of flexibility than was ever possible before.



PREMIER INCREASES GASOLINE YIELD WITH UOP FLUID CATALYTIC CRACKING UNIT

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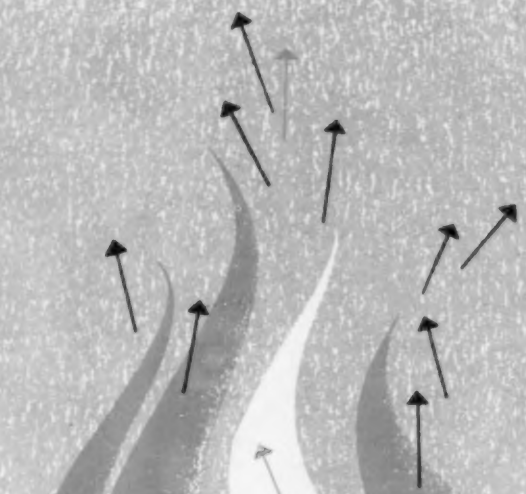
(To obtain more data on advertised products see page 1260)



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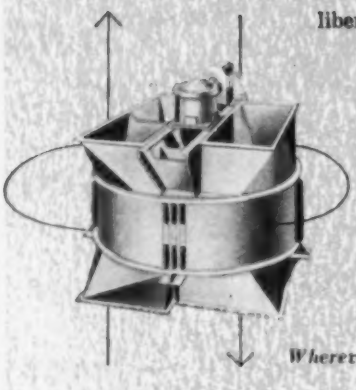

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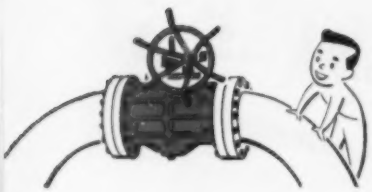
Let's Face the Facts...

DOES VALVE LUBRICATION

Now and then someone revives an old argument—"it costs too much to maintain lubricated valves."

On the surface, that sounds logical. But if that really was a fact, millions of Nordstrom lubricated valves in service today could never have been sold.*

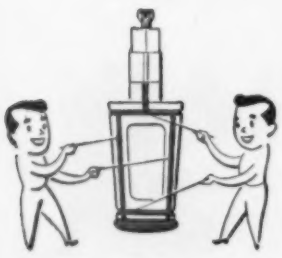
WHAT IS THE ADVANTAGE OF A LUBRICATED VALVE?



The most important function of lubricant in a Nordstrom valve is to give a tighter seal than can be accomplished through any other method yet developed. The thin film of plastic lubricant that is forced around the ports of the plug is a pressure seal in itself.

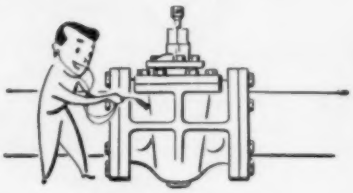
Of course, the lubricant has other obvious advantages—the same advantages it has in your automobile, or in any other mechanical equipment where metal rubs metal. The lubricant all but eliminates the possibility of galling or seizing, and consequently keeps the valve ready to operate in a hurry. A lubricated Nordstrom valve operates easily even against high line pressures, because the plug turns *within* the line, rather than being forced or wedged *against* it. Since it takes only a quarter turn of the plug to open or close the valve, it operates in seconds instead of minutes.

WHAT DOES THE LUBRICANT DO?



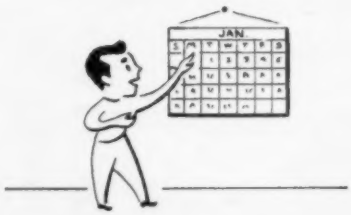
In a Nordstrom valve, lubricant is forced through a series of grooves surrounding the plug ports. There it acts as an extra seal against the little leaks that become big problems. It is also forced into a lubricant chamber at the small end of the plug where it serves as a hydraulic jack to keep the plug easy to turn. Finally, it *lubricates* . . that is, it prevents grinding wear, fills tiny imperfections that may develop, and it lets the plug slide without grating.

WILL A NORDSTROM VALVE WORK WITHOUT LUBRICANT?



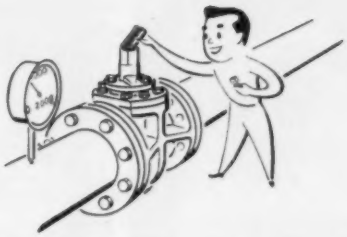
Yes, but then the whole advantage of a lubricated valve is lost. Your car will also operate without lubricant, but with proper lubricant, it is far more efficient, lasts many, many times longer, needs much less maintenance, and is safer. So is a valve. Nordstrom is fundamentally a valve—a plug valve made to exceptional standards of tolerance and quality—but it is the internal Nordstrom lubrication system which raises its performance standards above ordinary valves.

HOW OFTEN SHOULD NORDSTROM VALVES BE LUBRICATED?



Like your car, that depends upon the service—the temperature, process, frequency of operation, etc. It's hard to generalize, but your Nordstrom sales engineer can advise you. Using Rockwell lubricants, made especially for Nordstrom valves, is one way to reduce frequency of lubrication in many cases. Also, Rockwell markets mechanical lubrication equipment to make scheduled lubrication easy. Nordstrom Hypreseal valves are now built with an external fitting so that it is unnecessary to remove any parts from the valve before lubrication.

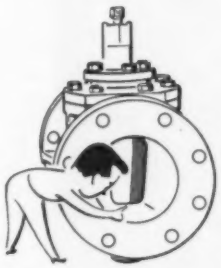
COST MONEY OR SAVE MONEY?



WHAT LUBRICANTS SHOULD BE USED?

Part of the effect of lubricating your car is lost if you use improper lubricants. That is also true of lubricated valves. Genuine Rockwell lubricants will save you money—they are the result of the longest and most extensive research into valve lubricants by any company. They are the result of years of field experience with nearly every process condition. For many services there are variations of Rockwell lubricants compounded to offset specific line conditions. Also, for many services Rockwell Hypermatic lubricant may be recommended. This lubricant, which is compressible and energizable, regenerates itself in the lubrication system, greatly reducing lubrication frequency. In any case, consult your Nordstrom sales engineer.

HOW LONG WILL PROPERLY LUBRICATED NORDSTROM VALVES LAST?



That's impossible to answer, since many of the first Nordstrom valves put into regular service are still going strong. The service has a lot to do with it, naturally. In gas service, there are many valves with more than 30 years service. In the valve-killing application of drilling rig mudlines, Nordstrom valves have been disassembled for inspection after more than 150,000 feet of hole on many occasions, found to be without wear, and returned for more service—often four times the life of ordinary valves. In a two-year paint plant test, Nordstrom valves were the only ones that did not need to be replaced because of leakage. Nordstrom files are full of such authentic field case histories—ask your Nordstrom sales engineer.

WHAT ABOUT MAINTENANCE COSTS FOR NON-LUBRICATED VALVES?

In any but the most simple services, any kind of valves need *some* maintenance. But in the case of Nordstrom valves, maintenance is generally confined to adding lubricant at intervals. Over a 20-year period, Nordstrom sales of repair parts have been less than half of one per cent of sales. In several plants in which records were kept and where Nordstrom and other valves were used, repair parts for Nordstrom valves ran about one-tenth of other makes.

The analogy to your car carries over here—if you don't lubricate it, you save on lubricant, but pay the far, far higher costs of part replacement. And more particularly, you'll need a new car much more often.

When you consider valve maintenance, be sure to count *all* the costs—not just simple service, but major repairs and complete replacement costs, shutdowns, extra labor to operate, and *all* factors.

If you do, if yours is a typical application, you'll find that year-in and year-out, the most economical valves you can use are Nordstroms.

If you'd like to discuss the suitability of Nordstrom valves for any service, let us know. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

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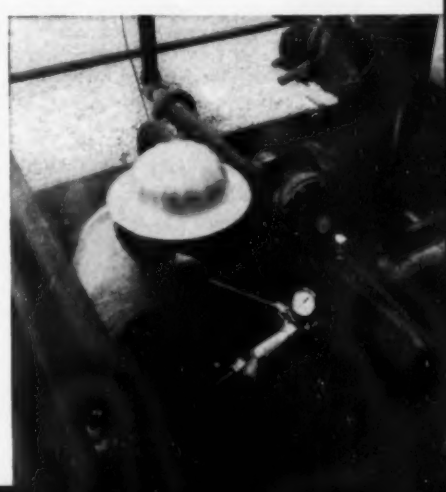
Lubricant-Sealed for Positive Shut-Off

* Nordstrom invented lubricated valves more than 30 years ago. Since that time, several million have been installed in hundreds of widely varied petroleum, gas, chemical and other process services. With by far the most complete range of sizes and pressures, and many patents on construction details, Nordstrom is the leader in lubricated valves.



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Extensive commercial operation of Houdriflow Catalytic Cracking units has proved that they achieve conversion rates previously unobtainable. A west Texas Houdriflow charging heavy vacuum gas oils has exceeded 90% conversion of the charge stock—a world's record. Only 3 to 4 percent of the original crude remained higher boiling than the Houdriflow charge stock.

In addition to record-breaking cracking efficiency, Houdriflow units have shown exceptional mechanical reliability. Turnarounds of units which have been on stream over two years have revealed minimum maintenance requirements.

A request on your letterhead will bring you a new brochure describing the Houdriflow process in detail. Flow diagrams and economics are included.

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PIONEER IN CATALYTIC PROCESSES

REFINERY PROCESS NEWS

PUBLISHED BY REFINERY PROCESS DIVISION, THE M. W. KELLOGG COMPANY AUG.-SEPT. 1954

Combination Processing Effects Big Savings in Direct Operating Costs

While first investment costs are probably as closely scrutinized as any other figures in planning a new oil refinery, the combination design offers several additional advantages over conventional unit-by-unit processing. One of the most important is found in direct operating costs. Substantial savings are possible in such items as labor, fuel, power, steam, water, and maintenance.

Although there are savings in maintenance charges and utilities —particularly through the conservation of heat due to the virtual elimination of intermediate storage —the largest reduction in direct operating costs for combination units is derived from smaller labor requirements.

Labor Requirements Reduced by More Than 20 Per Cent

Total operating personnel needs may be slashed by about 30% while total refinery personnel which includes clerical, maintenance and supervisory staffs, may be cut more than 20%.

For example, a 10,000 BPD conventional plant requires an estimated payroll of 90 operating men in comparison with 63 for a combination refinery. As far as total personnel are concerned, the comparison shows 206 versus 157. Studies of 20,000 BPD and 40,000 BPD capacity installations indicate similar low labor requirements for combination plants.

In addition to the savings already mentioned, combination refining has a further advantage in improving yields by reducing evaporation and other losses. About a 1% increase in gasoline yield can be expected in a 10,000 BPD combination unit, or about 4,200 gallons daily.

Together with savings in first costs, operating savings can increase the percentage return on a combination refinery up to one and one-half to two times that of a plant comprising individual units.

20 to 25% Investment Savings Spur Use of Combination Processing

A total of six combination refinery projects underway by Kellogg —all but one of them completely new refineries—spotlight the fact that the combination processing principle is an important answer to the petroleum industry's increasingly competitive market picture. More than sufficient incentive for the trend has been the possibility of slashing as much as 25% from the total cost of a new refinery by combining the various process steps into a single, centrally controlled operation.

Combination processing is, of course, not a new idea. A fundamental chemical engineering technique, it was first applied to refining in the early thirties when Kellogg engineered several prototypes of modern integrated plants. After World War II, the present trend began in earnest once stable competitive conditions returned to the market and processing economics again became primary considerations.

The postwar building program saw numerous combination thermal cracking refineries in South America, Europe and the Middle East. In the U. S. and Canada, the trend has continued with new combination refineries as well as expansion and modernization programs in which existing units have been integrated with new facilities. And in many programs, the original concept was extended to catalytic processes including cracking, alkylation, polymerization, and reforming.

Major Savings Achieved in Two Principal Areas

In designing a plant as a combination operation (as opposed to the conventional design wherein a series of individual, independently controlled process units are each complete with intermediate storage) investment costs are cut in two important categories. Perhaps the most obvious is in the elimination of intermediate storage and other off-site facilities. Economic studies, later proved by experience, have shown that for a combination plant, cost of off-site facilities can be reduced as much as 40%.

Other savings stem from economies in process equipment. By skillful integration, the same fur-

(Continued on reverse side)

REFINERY PROCESS NEWS

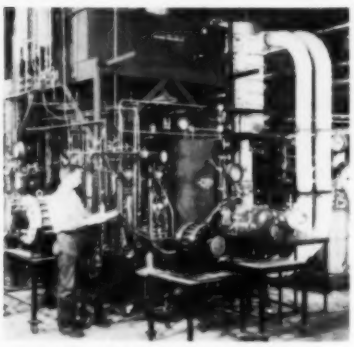
CONTINUED FROM PRECEDING PAGE

(Continued from previous page)

20 to 25% Savings...

naces can be made to serve more than one purpose; towers can be made to handle streams from more than one operation; the number of pumps can be radically reduced since intermediate products are not stored between processing steps; and, for the same reason, heat is retained in the stream from one process step to the next so that the number of heat exchangers is reduced throughout the refinery. Final savings in process equipment alone can be anywhere from 5% to 15%.

The overall effect of these savings adds up to the possibility of erecting a complete new refinery—in combination—for around 20% to 25% less than the cost of building comparable equipment incorporating separate process units.



KELLOGG PILOTS SUPPLY DESIGN DATA ... this unit is utilized to study the combination operation of a catalytic reformer with a desulfurization plant.

For further information, technical data, etc., on any refining process, write

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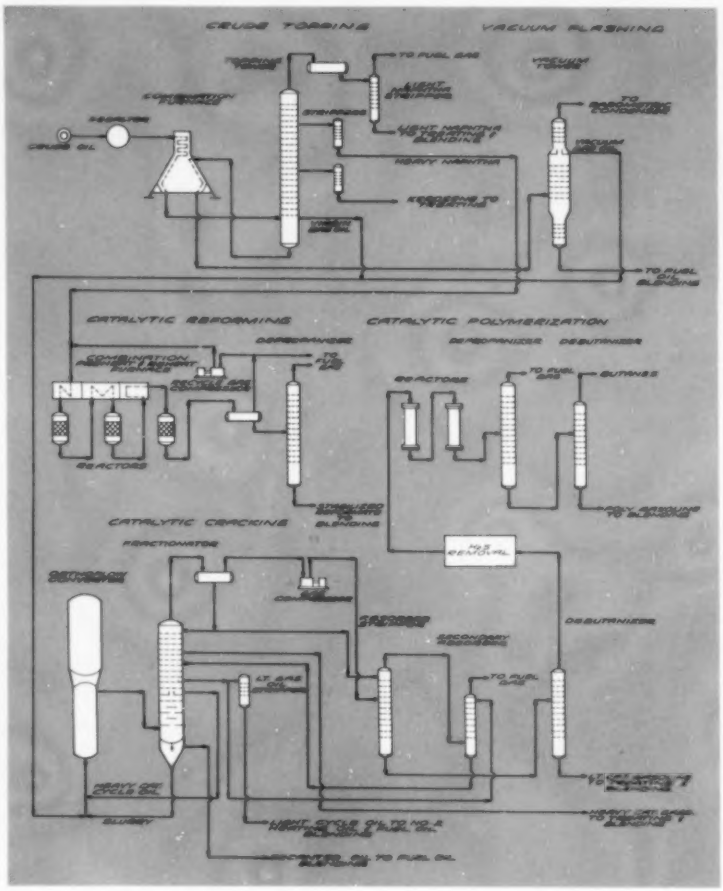

Flow Chart Highlights Savings...

The variety of processing sequences that may be operated in combination is limited only by the number of processes available or desired. The accompanyirg simplified flow sheet shows one type of combination refinery. It includes topping, catalytic reforming, vacuum flashing, Orthoflow fluid catalytic cracking, gas recovery and catalytic polymerization. The flow of oil is clearly indicated.

As can be noted, combination has effected a number of economies in investment costs. One furnace handles the heating requirements of the topping unit and vacuum flasher instead of the conventional two. A combination furnace is also employed in the reforming step.

Further savings are obtained in the cat cracking step. No charge furnace is required because the gas oil from both the topper and vacuum flasher is at a high enough temperature to be fed directly to the unit.

These are some of the more obvious investment savings reflected in the flow chart. Others include elimination of intermediate storage, reduction in heat transfer equipment, lower pumping requirements, and elimination of control room duplication.

In some types of combination plants, one tower may serve the fractionating requirements of two or three different processes. Another instance of a unique processing advantage is that one process can be made to eliminate a component which has a deleterious effect on a subsequent process: e.g., combination catalytic polymerization and alkylation wherein the cat poly process reduces the amount of butene-1 in the C_4 cut, a component which otherwise lowers the octane of the alkylate product, although it is the best butene for polymerization. These are but a few of the many advantages which can accrue from combination design.

Just name the valve needed--

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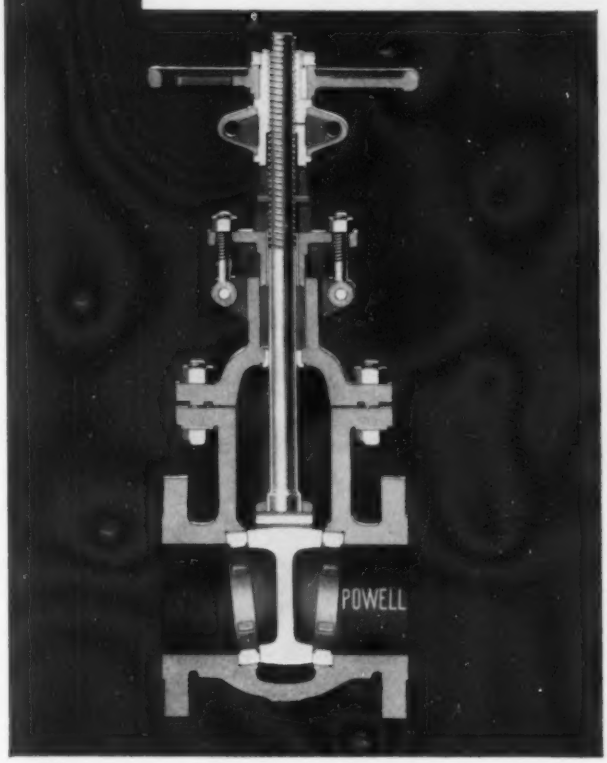

FIG. 1503 (*sectional*) **—150-POUND CAST STEEL GATE VALVE.** Flanged ends, bolted flanged bonnet with outside screw rising stem and yoke. Solid wedge. Available in sizes 1″ to 24″, inclusive.

You'll find just the valve you need in the complete line of Powell Valves. For Powell probably makes more kinds of valves—and has solved more valve problems—than any other organization in the world.

And Powell Valves have a record of dependable flow control since 1846.

Powell Valves are made ⅛″ to 30″ and 125 pounds to 2500 pounds W.S.P. Bronze, iron, steel and corrosion resistant alloys. Available through distributors in principal cities. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

FIG. 3061—300-POUND CAST STEEL SWING CHECK VALVE. Bolted flanged cap. Heavy rugged construction. Available in sizes 1″ to 12″, inclusive.

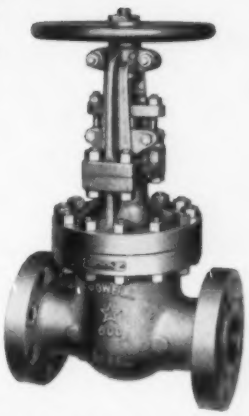

FIG. 6003—600-POUND STEEL GATE VALVE. Flanged ends, outside screw, rising stem. Available in sizes 1″ to 24″, inclusive.

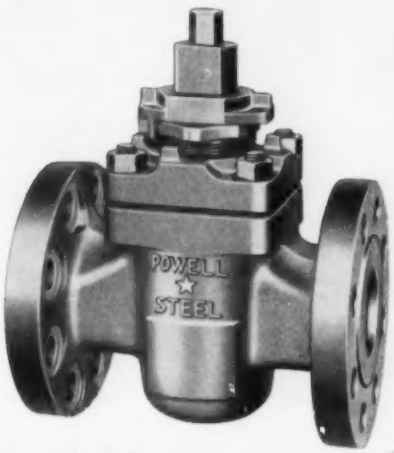

FIG. 1559—150-POUND STEEL FLANGED END LUBRICATED PLUG VALVE. (300-pound Steel, Fig. 3059.) Available with Screwed or Bolted Glands. Semi-Steel valves available for 175 and 200 pounds W.O.G. Carbon Steel valves available for 150 and 300 pounds W.P.

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 (To obtain more data on advertised products see page 1260)

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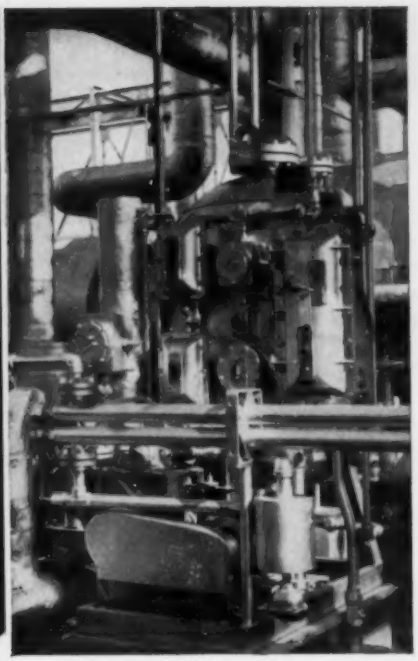

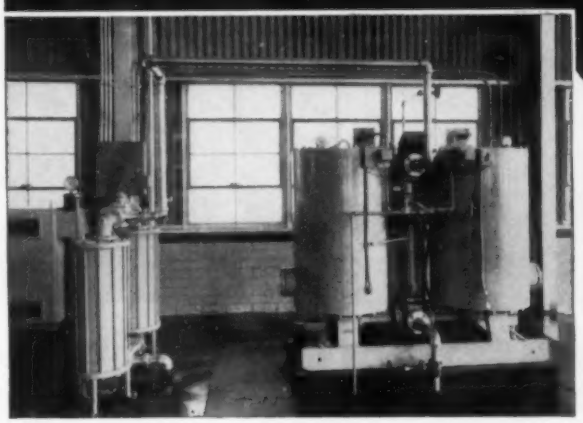

The complicated equipment in the top picture might have been impossible 22 years ago! It's a Lectrodryer* drying propane at the TGT plant in Gabe, Ky. Such special drying equipment is possible today because of the wealth of application know-how we have built up over 22 years. That's how long we've been solving moisture problems for the oil and gas industry.

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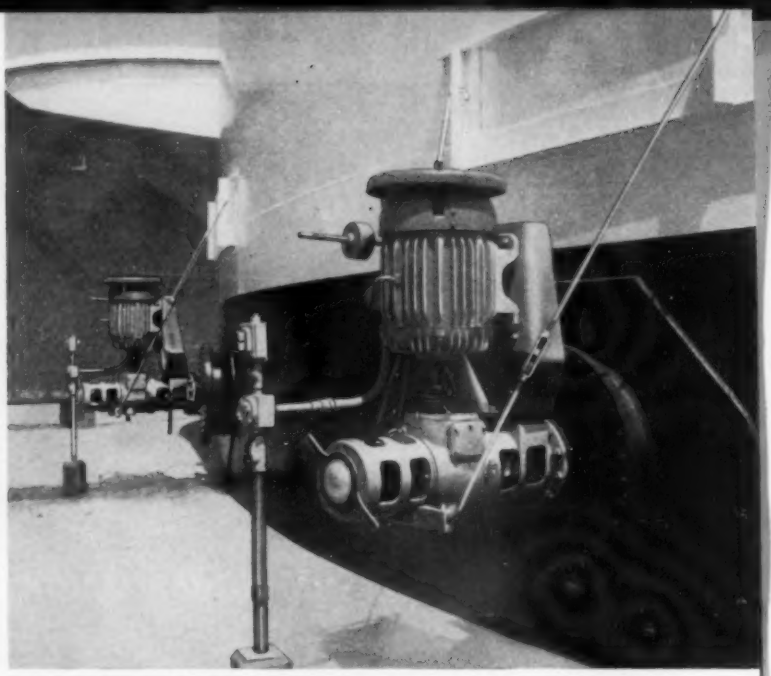

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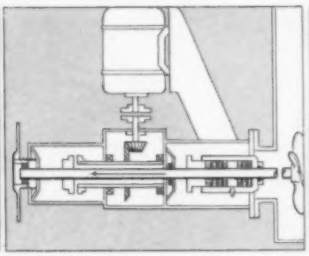
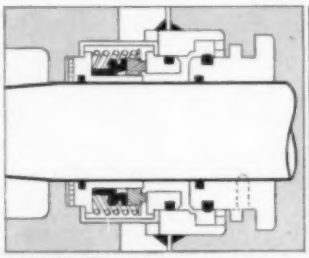
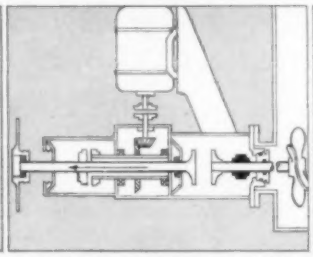


...retracts the mixer shaft outward, like the stem of a valve. Inside the tank...

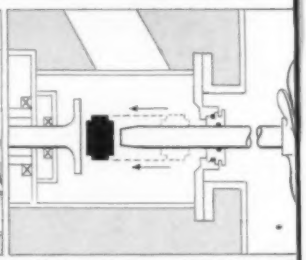
...a Teflon "O" Ring squeezes against the shaft and flange hub, keeping product safely in the tank while you change packing.



ROTARY SEAL ends repacking—forever. Seal runs without adjustment for its lifetime. Easy to replace, too...



...Shaft comes apart. Tank end of shaft locks in place and seals liquid safely in the tank...



...Shaft coupling is removed. Seal comes off *as a unit*. New seal goes on *as a unit*. In a few minutes, you're back in operation.

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- ☐ B-102 Top Entering Mixers (turbine and paddle types)
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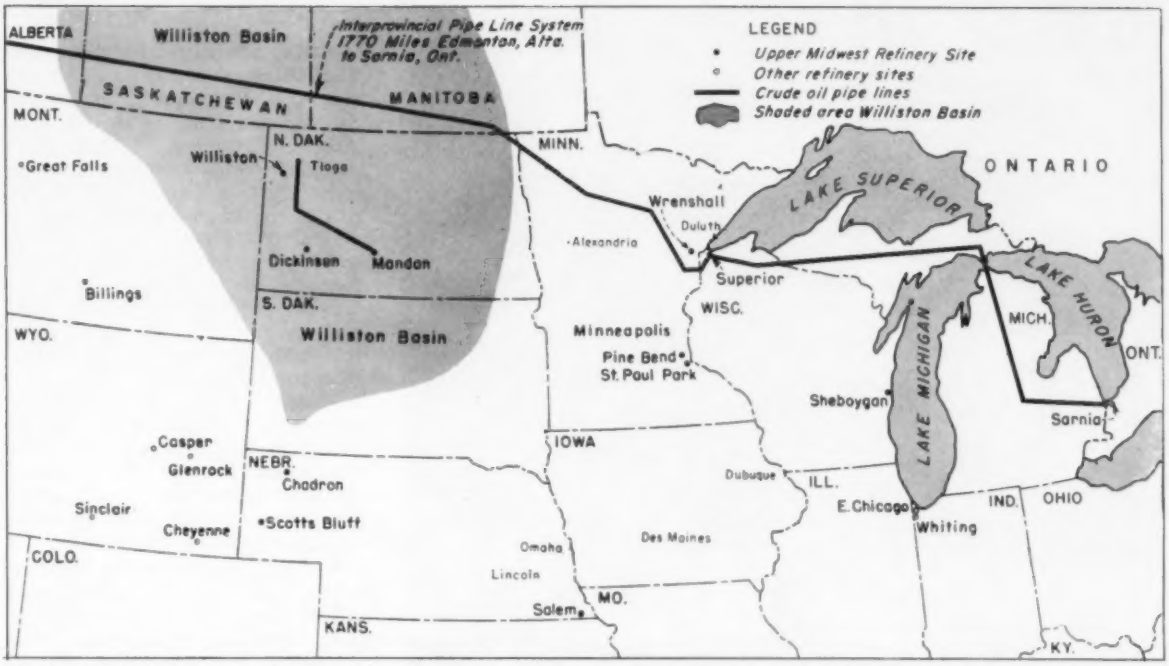


THE WILLISTON BASIN OIL FIELDS, together with the new producing areas in western Canada, are a strategic source of petroleum supplies for the north central farm states, and are already stimulating the building of new refineries in this territory

Upper Midwest to 'Refine Its Own'

Local plants of relatively "small" capacities will process Williston, Canadian crudes

A Staff Report by the Editors of PETROLEUM PROCESSING

A NEW district for "small" refineries of a few thousand up to 30,000 b/d capacity is developing in the Upper Midwest—the Dakotas, Minnesota and Wisconsin.

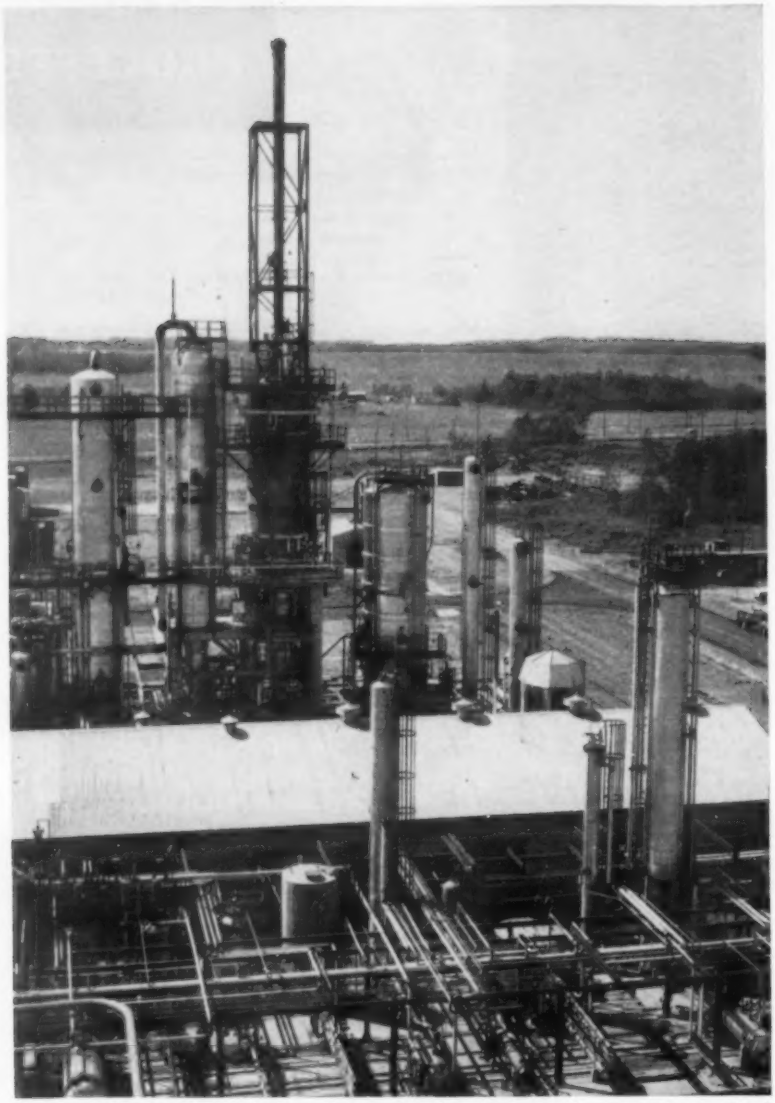
In an area which a year and a half ago had six operating refineries with a total capacity of about 20,000 b/d, today there are ten plants either proposed, under construction, being expanded or in operation—and projected capacity is over 100,000 b/d.

That may not seem large when you compare it with, for example, the million b/d capacity of the main refineries in the Philadelphia-New York area. But remember that the Upper Midwest isn't blessed with the convenient water transportation for shipping crude in and products out which is provided by the Atlantic Ocean. Also, the population of the cities of Philadelphia and New York alone is more than the total population in the four states of North and South Dakota, Minnesota and Wisconsin.

There are three main reasons for the development of the Upper Midwest as an area in which the small refinery can operate profitably:

- The expanding development of the new oil fields in the Williston Basin and in Western Canada. These fields assure this portion of the U. S. ample long-range supplies of good quality crude much closer than the present sources in the Mid-Continent and the Southwest.
- The nature of the market to be served from

FOR OPINION... on what refiners in the Upper Midwest should look out for, read... "LESSONS FROM THE PAST" page 1292



COMPACTNESS OF DESIGN features the new combination-type refinery of International Refineries, Inc., Wrenshall, Minn., typical of the new refining development in the Upper Midwest

Refineries Existing and Building in the Upper Midwest

Company	Location	Capacity b/d	Status
MINNESOTA			
Northwestern Refining Co.	St. Paul Park	30,000	Expanding
Great Northern Oil Co.	Pine Bend	25,000	Building
International Refineries, Inc.	Wrenshall	11,000	Operating
NORTH DAKOTA			
Standard Oil Co. (Indiana)	Mandan	30,000	Building
Queen City Oil & Refining Co.	Dickinson	2,500	Operating
Williston Basin Refining Corp.	Williston	1,500	Building
NEBRASKA			
Cooperative Refining Assn.	Scotts Bluff	2,000	Operating
Searle Petroleum Corp.	Salem	1,000	Part Operating
Sioux Oil Co.	Chadron	600	Standby
WISCONSIN			
Lake Superior Refining Co.	Superior	6,000	Operating
Wisconsin Oil and Refining Co., Inc.	Sheboygan	5,000	Operating
	Total	104,100	

the new refineries. It covers a wide geographical area of six states or more, where the per capita consumption on farms and in small towns is large and growing. There are no heavily industrialized sections of concentrated population, where big refineries would be logical.

• Advances in refining technology. These have resulted in small but efficient catalytic cracking, catalytic reforming and other processing units. Also, improvements in design have provided the so-called combination refinery, which can be built at per-barrel investments and operated at per-unit costs more closely in line with those of large refineries than was formerly the case. These available facilities provide for plants of small capacity producing the quality motor fuel and other products needed to meet today's competition.

Plans for the new refineries already announced for this territory, and for the plants being expanded, give some clue to the nature of other refineries that will be built later to take advantage of the economically favorable supply and market factors.

• Great Northern Oil Co. is putting up a 25,000 b/d crude capacity plant at Pine Bend, near Minneapolis. The main processing units include crude distillation, tar separation, delayed coking, Thermofor catalytic cracking, hydro - desulfurization, Ultraforming (catalytic reforming), catalytic polymerization and gas recovery. Reported capital investment is $25,000,000.

The plant was integrally designed and constructed to provide for the minimum amount of condensing and reheating of materials during the process sequence and is similar to the combination type, except that tankage was installed between the processing units to provide means for avoiding a plant shutdown when an individual unit has to be taken off stream.

This refinery will operate on crude of 21-24° API gravity from the Fosterton field, in Saskatchewan, and the coking unit is being installed because the company believes it can find a readier market for coke than for the volume of heavy fuel oil it would otherwise be producing.

President and operating head of the new Great Northern Oil Co. is William J. Carthaus, who was until recently manufacturing head of Deep Rock Oil Corp. and is one of the most experienced refiners in the Mid-Continent.

• Standard Oil Co. (Indiana) is building a combination refinery of 30,000 b/d charge capacity at Mandan, N. Dak., to run on Williston Basin

PRODUCT PIPELINES FAN OUT in the Upper Midwest, already serving this area with a good share of the gasoline and distillate products being consumed

crude. Facilities include crude topping, Fluid catalytic cracking, vapor recovery and polymerization, and fixed bed Hydroforming. Reported investment in the refinery and a new products pipe line from Mandan to Moorhead, Minn., is about $30,000,000. The company has already built a crude line to Mandan from the Williston Basin fields.

• International Refineries, Inc., completed a year ago a 11,000 b/d crude capacity plant at Wrenshall, Minn., which is said to be the first combination refinery built in the U. S. Some 10 processing and treating steps are tied into the integrated processing sequence. Processing units, in addition to crude topping, are Fluid catalytic cracking (5000 b/d capacity of fresh and recycle stocks), gas concentration, and catalytic polymerization. Finished products will be motor gasoline, range oil, diesel fuel and heavy fuel oil. The refinery, designed by the Lummus Co., will run on western Canada crude as it is conveniently located to the Lakehead section of the Interprovincial Pipe Line system.

• Williston Basin Refining Corp. is building a 1500-b/d crude unit and a catalytic reforming unit licensed by Atlantic Refining of 300-b/d capacity; also a gasoline and light oil treating plant. It will process Williston Basin crude.

• Queen City Oil & Refining Co. has completed the crude topping unit at its 2500-b/d plant at Dickinson, N. D., near the Williston Basin, and its cracking plant will be completed this fall.

• Northwestern Refining Co.'s plant at St. Paul Park, one of the first refineries built in Minnesota, is being enlarged from 8000 to 30,000-b/d capacity. The crude distillation unit is being revamped to raise the capacity from 8000 to 12,000 bbls. An 11,000-bbl. catalytic "cracker" has been installed and a new 15,000-bbl. crude topping unit is to be built.

• Lake Superior Refining Co. is among the smaller refiners in the Upper Midwest. Its plant at Superior, Wis., was formerly the Carter Oil Co. refinery at Cut Bank, Mont., which was dismantled and reerected in Superior in 1951. It is now operating at the rate of 6000 b/d. Processing facilities include crude distillation, vacuum unit for producing asphalt and a Thermofor "cat cracker." A UOP

Properties of Crude Oils from the Williston Basin
(From Analyses Made at the Bureau of Mines Experiment Station, Laramie, Wyo.)

Field	Sample Identification		Characteristics of Crude Oils					Yields, Vol-%	
	Producing Limestone	Depth feet	Gravity Spec.	Gravity °API	Sulfur wt.%	Visc., SUS 100°F.	Pour point, °F.	Gasoline & Naphtha	Gas Oil
Montana									
Deer Creek	Red River	9,957-10,073	0.816	41.9	0.12	38	< 5	30.9	35.4
Glendive	Red River	8,970- 9,060	.838	37.4	.12	71	< 5	28.2	32.9
Glendive (Cedar Creek)	Devonian	8,740- 9,155	.831	38.8	.19	40	< 5	27.7	34.7
Little Beaver	Ordovician	8,313- 8,525	.878	29.7	.57	82	< 5	21.4	26.0
Pine Unit	Devonian	8,910- 8,970	.856	33.8	.36	55	< 5	24.7	31.7
Poplar, East	Madison	5,799- 5,827	.827	39.6	.32	38	< 5	33.8	29.8
Poplar, East	Charles	5,648- 5,680	.824	40.2	.33	37	15	34.1	29.4
Poplar, West	Charles	6,176- 6,184	.827	39.6	.35	35	< 5	39.3	28.0
Richey	Charles	7,183- 7,275	.831	38.8	.53	38	10	35.4	27.4
Richey, Southwest	Devonian	9,090- 9,145	.786	48.5	.17	<32	< 5	45.1	34.7
Woodrow	Madison	7,902- 7,914	.865	32.1	.97	44	25	30.0	23.9
North Dakota									
Beaver Lodge	Devonian	11,630-11,660	.767	53.0	<.10	<32	< 5	57.0	28.5
Beaver Lodge	Madison	8,520- 8,528	.812	42.8	.24	34	< 5	42.3	25.0
Charlson	Madison	8,998- 9,042	.811	43.0	.22	33	< 5	43.1	26.0
Croff	Madison	9,515- 9,570	.816	41.9	.50	34	< 5	44.2	24.4
Keene	Madison	9,066- 9,110	.808	43.6	.20	33	< 5	43.9	26.1
Tioga	Madison	8,258- 8,290	.819	41.3	.31	35	< 5	40.7	26.6
Tioga, East	Madison	8,364- 8,386	.839	37.2	.80	37	15	35.7	26.0

Platformer is now being installed.

• Wisconsin Oil and Refining Co., Inc., operates a 5000-b/d refinery at Sheboygan, Wis., and is now increasing to 1500-bbls. capacity a 1000-bbl. catalytic reformer.

Studies on the processing of the new Canadian and Williston Basin crudes have been made by M. W. Kellogg Co., refinery engineers, on a pilot plant scale. Commercial plant cost estimates have also been drawn up on the assumption that a number of refineries with crude capacities as low as 5000 b/d, will be built in this territory in the next few years.

On the basis of their studies they estimate a combination type 10,000-bbl. refinery to process Redwater, Alberta Province, crude would have an investment cost of around $15,000,000 and a 5000-bbl. plant with the same facilities would cost $10,500,000. Plant design would include vis-breaking as well as vacuum distillation.

With Williston crudes, which are higher gravity than Redwater, it is believed vacuum flashing can be eliminated from the processing sequence and the reduced crude fed directly to catalytic cracking. By eliminating this step the overall cost (plant and offsite) could be reduced 4-5%.

With a combination type refinery of 10,000-bbl. capacity, in this territory, the Kellogg engineers estimate that savings of around 22% on investment and 15% on operating costs could be made, as compared with the cost of a new refinery of individually designed units. A 20,000-bbl. combination refinery would achieve a saving of 20% on investment and 11% in operating costs as compared with a conventional installation. Facilities included would be crude topping and vacuum flashing, catalytic cracking and gas recovery, fixed bed catalytic reforming and catalytic polymerization. The investment savings with combination refineries come principally from reducing the offsite facilities required, the intermediate storage, consolidating building, piping and so on. In operating costs, while there are savings in utilities and maintenance charges, the largest saving comes from smaller labor requirements. In 10,000-bbl. refineries, savings up to 25% in the number of operating personnel can be achieved.

The Market for Petroleum Products in Upper Midwest States
(Gallonage Figures are for 1952)

State	Population	Gasoline (1000 gals.)	Middle Distillates (1000 gals.)	LP Gases (1000 gals.)
Iowa	2,538,270	1,006,271	552,048	81,855
Minnesota	2,792,300	1,003,968	753,858	55,839
Nebraska	1,315,835	513,327	211,890	84,523
N. Dakota	641,935	279,159	142,716	40,369
S. Dakota	642,960	296,467	133,518	31,044
Wisconsin	3,137,590	1,804,252	606,606	85,687
Total	11,068,890	4,183,444	2,400,636	379,317
U.S. Total	131,669,275	46,428,148	25,277,238	4,477,379
% of U.S. Total Consumed in Upper Midwest	8.4%	9.0%	9.5%	8.5%

Two sources of crude supply will be available to the new refineries going into the Upper Midwest—the Williston Basin in this country and Canada, and the new Canadian fields in the Alberta and Saskatchewan Provinces. Extensive wildcatting is going on in Nebraska and this state may later become a substantial oil producing area.

The Williston Basin fields were opened in April, 1951, when oil in commercial volume was discovered in North Dakota. The present and potential producing structures, of which there are several, are known to cover an area of some 120,000 square miles, in North Dakota, northwestern South Dakota, eastern Montana and extending into the southern portions of Alberta and Saskatchewan Provinces. Unofficial estimates of the reserves of petroleum in the Basin run from three to five billion barrels.

Most of the large oil companies hold extensive acreage in the Basin. The North Dakota section is 300 to 500 miles from the center of good products markets, about half the distance from the Mid-Continent fields. Pipe line outlets from Williston Basin are yet in the planning stage, except for the short line of Standard Oil Co. (Indiana) from Williston to Mandan, N. Dak., and the oil now taken out moves by rail and water to the existing small refineries now operating in this portion of the country.

The new fields in western Canada

came to attention six years ago when a commercial discovery was made at Leduc, near Alberta. Later developments tend to extend the potential producing area, and the known underground reserves as of Dec. 31, 1953, were estimated at over 2,000,000,000 bbls. Production in Alberta Province averaged 240,000 b/d in the first quarter of 1954. Most of the oil marketed moves via two pipe line systems, one to the east and one to the west to British Columbia. The Alberta fields are about 1100 miles by pipe line from the head of the Great Lakes, at Superior, Wis.

Orderly development of the fields is insured, and it is extremely unlikely that refiners coming into the territory in the period of flush production of the new fields will ever be able to buy their crude at "bargain" prices, as was true with some of the earlier large new oil fields in the U. S. In the unrestricted development of the East Texas oil fields 20 years ago, crude sold for 25¢ a barrel and some of the skimming plants built there paid out their investment in a few months.

In Williston Basin and western Canada a number of natural factors work against their crude being sold at prices greatly out of line with the established crude price structure of the Southwest and Rocky Mountain areas. The cost of finding and producing the oil will be high compared with that of the established fields. Some of the producing structures in Williston Basin are 12-13,000 ft. deep. Except for small shipments by rail, movement of the oil will be entirely dependent on long pipe lines which require a large investment. Williston Basin as yet has only one pipe line outlet, the Indiana Standard's line to its Mandan refinery, which is now building.

Another price protective factor, for both the western Canada and Williston Basin areas is that the development work has been done mostly by the large U. S. oil companies who already have heavy investments there and will want to maintain orderly development of the fields.

Aside from the above factors the generally accepted practice of conservation of oil and gas production within the states in the U. S. and by the provincial governments in Canada will put the brake on unrestricted development of the new fields. North Dakota and Montana are members of the Interstate Oil Compact Commission, which, with the sanction of Congress, supervises and regulates drilling and producing operations in the oil fields. The General Rules and Regulations for the Conservation of Crude Oil and Natural Gas in North Dakota, of the state Industrial Commission, adopted last December, give the Commission authority to require drilling permits, set well spacing units, determine market demand and regulate the volume of production of its oil fields. In Alberta Province the government's Petroleum and Natural Gas Conservation Board supervises letting of drilling permits, sets the allowables for production and also advises on applications to build pipe lines into the producing areas.

Characteristics of the crudes are of interest to refiners studying the possibilities for new plants. They will find in general that the crudes from the Williston Basin and new Canadian fields compare favorably with similar gravity oils in the Mid-Continent. In the Basin, wells are producing from several structures at from 6,000 to over 12,000 ft. deep. The API gravity runs from around 30 to over 50, with the average for various fields 40-43. Sulfur content is low, under 0.50 in most fields. Gasoline and naphtha yields run from 35% to 57% in one field, with the yields in several fields averaging 40-42%. Gas oil yields run from 25% to 35%, with that in most fields being 26-29%. An accompanying table, made up by the Laramie, Wyo., Station of the Bureau of Mines, gives the characteristics of several Williston Basin crudes.

The Alberta crudes run from 33-40 API gravity. Except in a few fields the sulfur content is well under 0.1% and in these few cases it is under 1.5%. They are comparable with Mid-Continent oils except in the three fields of crude of higher sulfur content (Big Valley, Redwater and Stettler). In addition to higher sulfur content these three fields also have a more asphaltic distillation residuum. Their gasolines compare favorably with those from the high grade crudes in the Mid-Continent except for their mercaptan sulfur content, which can be reduced with very little treating. Their Diesel fuels also compare favorably with those from the Mid-Continent. Some of the crudes in the Saskatchewan fields are lower gravity than those in Alberta.

Pipe lines will be important in the development of the Upper Midwest area. At present, the Alberta and Saskatchewan fields are served by two pipe line systems. The Interprovincial and Lakehead (in the U. S.) Pipe Line carries crude 1130 miles from Edmonton to Superior, Wis., and 643 miles from Superior to Sarnia. Capacity to Superior is 171,000 b/d and into Sarnia 110,000 b/d. There is talk of extending the line to either Toronto or Buffalo. The Trans Mountain line moves Alberta crude in the opposite direction 718 miles from Edmonton into British Columbia. Present capacity is 150,000 b/d.

In the design stage is the Minnesota Pipe Line Co., which will build a line 155 miles from the Fosterton field in Saskatchewan to a connection with the Interprovincial system at Regina, Sas., and from a takeoff point from the Interprovincial line in Minnesota to St. Paul Park to supply 20,000 b/d of crude to the new refinery of the Great Northern Oil Co.

The Williston Basin fields are now served with one crude oil line, that of Indiana Standard from Tioga in North Dakota about 150 miles to Mandan.

Markets to be logically supplied from the new oil fields include the Dakotas, Nebraska, Minnesota, Iowa and Wisconsin (the last two at least in part) and maybe sections of other states to the east. The six states mentioned have a geographical area of nearly 421,000 square miles and a population of 11,068,885. The area is very largely agricultural, and in the six states there are only six cities of over 100,000 and three of these are in Minnesota. Largest concentration of population is in the Twin Cities, around 800,000. An accompanying table shows for the six states their consumption of gasoline, middle distillate products and LPG for 1952.

New refineries establishing themselves in this area will not pick up existing business there in gasoline, tractor fuel, heating oils and so on without a struggle from the oil companies now serving the area from refining plants further removed. The jointly owned Great Lakes Pipe Line Co., whose product lines now extend from Mid-Continent refineries up into Minnesota and North Dakota, has announced extensions of its system in Minnesota, the Dakotas and Iowa.

The Upper Midwest also receives product supplies by barge via the Mississippi waterways.

Standard Oil Co. (Indiana) has completed a products line 205 miles from Mandan, its new refinery site, to Moorhead, in western Minnesota.

International Refineries, Inc., is reported planning a products line 130 miles from its refinery at Wrenshall, near Duluth, to the Twin Cities area.

The Upper Midwest is already well served by product pipe lines while, by contrast, crude oil lines at present are almost non-existent.

NOTE: the photograph on page 1186 was furnished, courtesy The Lummus Co.

THREE STEPS TO SAVINGS IN

Running a 10,000 b/d Cat Cracker

By JOHN W. WARD and G. N. KAVOURAS
National Cooperative Refinery Ass'n., McPherson, Kans.

DIRECT net savings of $460 per day, together with indirect savings through more efficient operations generally, have been achieved in a 10,000 b/d Universal Oil Products stacked type fluid catalytic cracking unit at the McPherson, Kans., refinery of the National Cooperative Refinery Assn., as the result of a modification program by the plant engineering department.

The $460 daily saving resulted from increasing the yield of a liquid product of the No. 2 burning oil grade by reducing the production of coke. This in turn was done by installing a slurry settler and modifying the catalyst stripper.

Restoration of the catalyst was improved by installing a distributor on the outlet of the spent catalyst return line to the regenerator, in order to bring about a more rapid mixing of the spent catalyst throughout the regenerator. Nipples were installed over the holes in the regenerator grid to provide further distribution of the catalyst.

The overall operation of the unit was also improved by changing the catalyst to a smaller particle size in the middle range. These improvements, which took place over three years' operation of the "cat cracker" are described below.

Lowering Coke Production—The unit was originally operating at 65% conversion and 7.3 wt.-% coke based on the raw oil charge. The fractionator bottoms were recycled to extinction and with the relatively large coke production, only a small amount of charge preheat was required.

An existing vessel was converted into a slurry settler to clarify the fractionator bottoms and an existing heater was put into charge preheater service to make up the heat deficiency due to lower coke production. The settler permitted the withdrawal of the material boiling above 575° F. EP (light recycle) from the fractionator bottoms instead of as a side stream.

The spent catalyst stripper was modified to help reduce apparent coke production still further. The angle of the bottom side-to-side tray was changed from 45° to 30° from the horizontal and part of another tray was added. The pressure drop through the steam distribution grid was increased to 10 psi. and a spider was installed to provide steam to the area just above the entrance to the spent catalyst standpipe. Table 1 illustrates the effects of the slurry settler and stripper modifications.

Because of the large amount of non-viscous material needed at this plant to cut back the vacuum reduced tar to No. 6 fuel oil, the increased liquid recovery brought about by the reduced coke production may be priced as No. 2 burning oil. This resulted in the marked saving of over $460 per day, which of course pays for these changes in a short time.

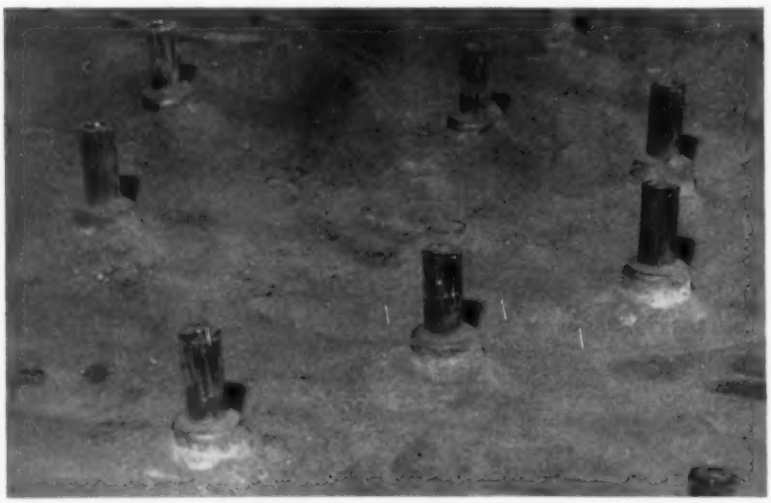
The catalyst stack losses, as a direct result of the decreased regenerating air, decreased from about 0.3 lb./bbl. of fresh charge to about 0.2 lb./bbl. of fresh charge. This enabled the refinery to withdraw substantial quantities of salable used catalyst and to operate with a better catalyst because of the great importance of actual catalyst withdrawn.

Increased regenerator cyclone life has been indicated by a decrease in metal loss since installation of the slurry settler.

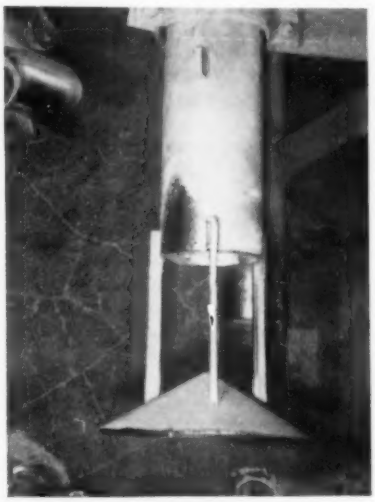
Improving catalyst regeneration—The following factors caused concern about the regenerator operation:

1—The regenerator always showed upon inspection that there were two distinct burning zones in the cross section of the vessel extending 10 ft. above the grid. One zone burned with insufficient oxygen and the other with high excess oxygen, as shown by the different colors of the regenerator metal internals.

2—When fresh catalyst loading air was cut into the regenerator, reactor temperature would drop and catalyst circulation would increase markedly. This indicated that catalyst was "pil-



BETTER AIR DISTRIBUTION resulted from increased pressure drop by installing these nipples in holes in the grid



BETTER CATALYST DISTRIBUTION resulted from this baffle over the spent cat line to regenerator outlet

ing" up around the circumference of the regenerator.

3—Carbon on the regenerated catalyst was running high (about 0.5%).

4—Severe afterburning would occur during even a small upset.

These problems were overcome by installation of special equipment. It had been observed that the falling spent catalyst had been occupying only a small portion of the downcomer.

Therefore the design of the distributor which was placed on the outlet of the spent catalyst return line (see photo) was somewhat arbitrarily based on this indicated high velocity head to distribute catalyst into the dense phase. The holes in the bottom plate have a diameter of 2 in. and the pipes are 4, 6 and 8 in. The large opening at the top would serve as an escape hatch in the event the pipes plugged off. However, inspection has shown that the catalyst has been flowing through all the lower openings with room to spare.

Some of the regenerating air was diverted through a nozzle above the grid to provide further distribution of the catalyst as it came out of the distributor.

It was desired to improve air distribution by increasing grid pressure drop without plugging more holes, and also by overcoming the effects of the curved and badly worn grid. The pressure drop was increased by welding ⅜-in. fitting over the existing holes and screwing in ⅜-in., Sch. 80, nipples 2 in. long (see photo). However, on the outer portions of the grid, ⅜-in., Sch. 40, nipples 6 in. long were used to help overcome the grid curvature.

The proper diameter and length of nipples were arrived at after tests simulating the flow conditions at and through the regenerator grid as close as was practical. Fig. 1 illustrates the results of the tests. The actual grid differential pressure after the nipples were installed was within 10% of the values derived from the tests. The plant operation was smoother with better catalyst regeneration and with much less afterburning.

After six months operation the nipples showed little or no wear, indicating that regenerator grid wear, as shown by the peculiar keyholing of the holes, should be nil in the future, thereby eliminating a costly item of fluid "cat cracker" maintenance.

Table 2 shows the effects of the regenerator grid changes and the spent catalyst return line changes with an essentially constant charging stock.

Changing the catalyst—The over-all operation of the "cat cracker" was further improved, as illustrated in Table 3, by changing to a catalyst of finer particle size in the middle range.

Summary—Coke production in fluid catalyst cracking units may be reduced substantially by withdrawing a net stream from the fractionator bottoms, thereby substantially increasing the over-all net liquid recovery. Catalyst stripper modifications may also have an effect on coke production.

Better catalyst fluidization and regenerator burning characteristics may be realized by improving catalyst and air distribution, and by careful selection of catalyst grades. In regard to air and catalyst distribution, NCRA feels that it has arrived at simple and effective methods which include inexpensive grid repair.

Table 1—Effects of Slurry Settler and Stripper Modification

	Before	After
Cat cracker charge, b/d.	10,000	10,000
Conversion, per cent	65	65
Coke wt.-%	7.3	5.5
Increased liquid recovery, light recycle b/d		180
Value of liquid recovery, $/day at 3.30/bbl.		605
Value of steam saved in compressing air, $/day		25
Total value of liquid recovery and steam saved, $/day ...		630
Value of gas to fire charge preheater, $/day		170
Net saving (before depreciation) $/day		460

Table 2 — Effect of Changes in Spent Catalyst Line and Regenerator Grid with an Essentially Constant Charge Stock

	Before Regen.	After Regen.
Carbon burned, lb/hr. ...	7000	7000
Regenerator temp., °F ...	1105	1095
Carbon on regeneration catalyst, %	0.50	0.43
Catalyst addition rates to maintain 29 activity, lb/bbl raw oil	0.31	0.26

Table 3—Effect of Change in Catalyst on Overall Operation

	Before	After
Regenerator:		
Carbon burned, lb/hr. .	7000	7000
Regenerator temp., °F ..	1095	1080
Carbon on regeneration catalyst, %	0.50	0.43
Reactor:		
Conversion, vol.-%	65	65
Combined feed ratio ..	1.4	1.4
Hourly space velocity, wt.	3.0	6.0
Reactor temperature, °F.	900	900

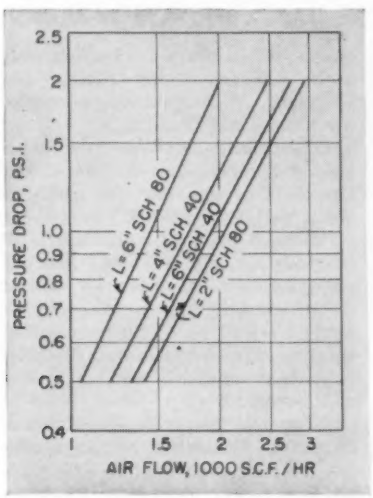


FIG. 1—Results of tests of air flow through the ⅜-in. nipples

Meet the Authors

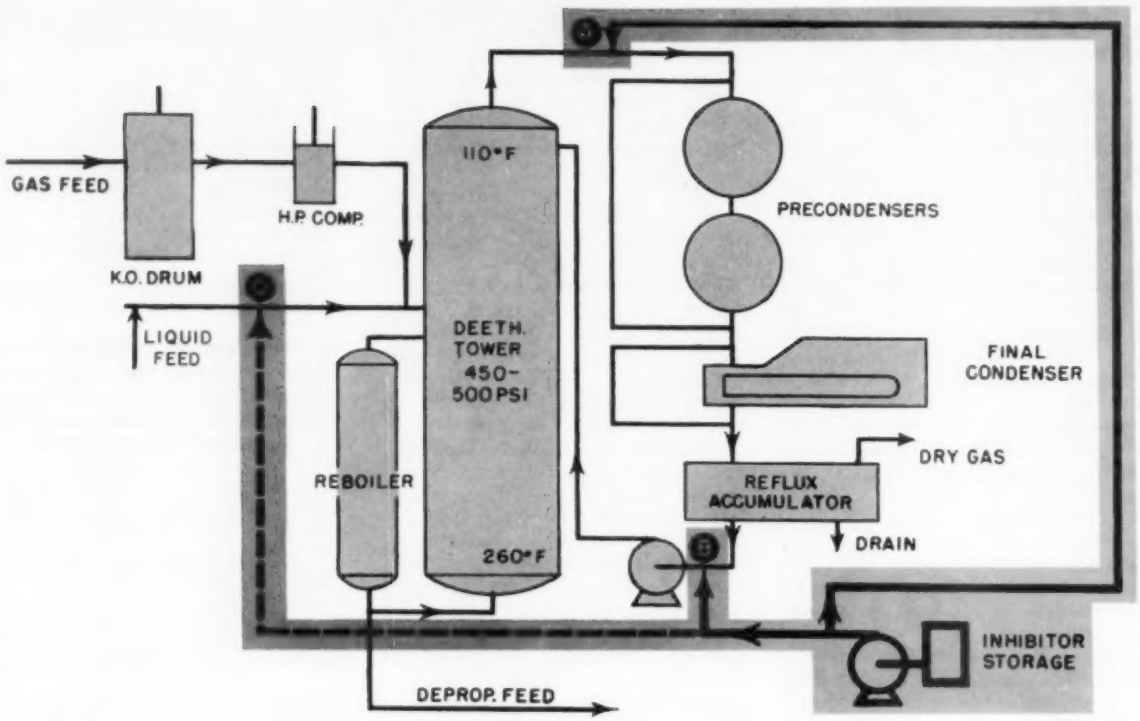
Mr. Ward

Mr. Kavouras

J. W. Ward, refinery division manager for the National Cooperative Refinery Assn., McPherson, Kans., graduated from the University of Kansas in 1932 and did graduate work in physieal chemistry at the University of Chicago. He worked a few years with a steel company and joined Universal Oil Products Co. in 1935 as a service engineer and in that capacity assisted in the startup of some of the first wartime aviation gasoline plants. From 1940-45 he was a process engineer with UOP in Chicago.

Mr. Ward then went with the Aurora Gasoline Co., Detroit, as chief engineer and in 1950 became associated with the NCRA in his present capacity. He holds patents in thermal and catalytic cracking.

G. N. Kavouras graduated from Texas A & M College in 1947 with a B.S. in chemical engineering. He worked for five years with UOP before joining the National Cooperative Refinery Assn. as process engineer.



INJECTING AN INHIBITOR at points "A" and "B" in this tower has reduced corrosion, prevented plugging of condensers, lengthened on-stream time. Point "C" is being studied as another injection spot

FIGHT CORROSION!
A Case History—No. 1

Cut Deethanizer

AT a daily cost of less than $6 for a chemical inhibitor, Sun Oil Co. has cut corrosion in a deethanizer tower at its Marcus Hook, Pa., refinery by 92%—and is still operating equipment which in 1949 had a life expectancy of only 2 years.

Ten years ago Sun put the deethanizer column into service at Marcus Hook. As indicated in the sketch above, it was of conventional design—carbon steel tower shell and trays, two pre-condensers with admiralty tubes and brass sheets, a final condenser with steel tubes, and carbon steel lines.

Operating pressure was 450-500 psi, with a temperature of 110° F. at the tower top and 260° F. at the bottom. Feed stock was 7,200 b/d of the overhead stream from a Houdry catalytic cracking unit. The feed contained 0.1% water, H_2S, and sulfur oxides—with water the bulk of contaminants.

Evidence of severe corrosion was apparent in the unit almost from the start. It was run a year after the initial start-up, and then brought down for its first inspection. At that time the condensers were found to be so badly plugged with iron sulfide scale resulting from corrosion in the unit that shutdowns every six months were called for.

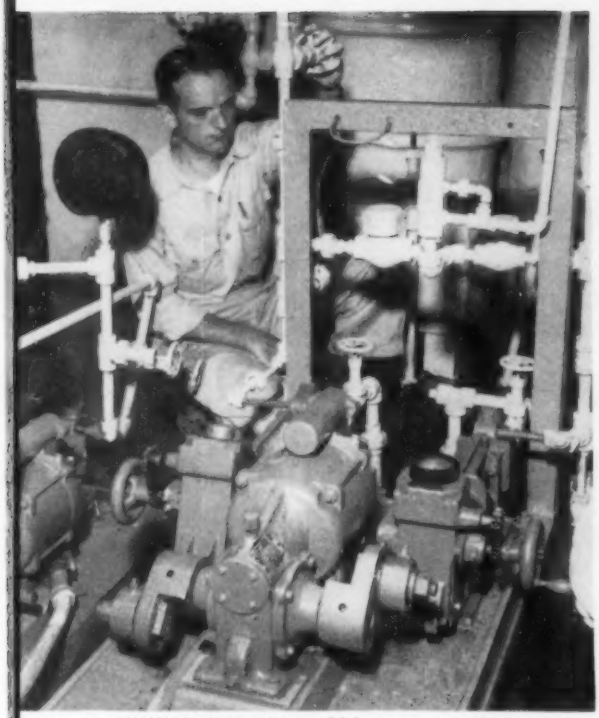
The reflux vapor line was replaced within 18 months, and then again within less than 4 years. Severe corrosion of the upper tower trays and lesser corrosion of the condenser tube bundles was also being experienced.

Even more serious, however, was the rate at which the upper portion of the column itself was being eaten away. Corrosion of the shell during the first 5½ years of operation was taking place at such a rapid rate that in 1949 Sun's corrosion engineers estimated that the column would have to be replaced within another two years—or that operating pressure would have to be reduced.

Replacement cost was estimated at around $50,000, and on top of that downtime of the unit was placed at about $10,000 per day.

The feed stock normally had a pH of about 4.5, and ammonia injection was undertaken in an effort to control the deterioration by raising pH to a level of 7-8. That wasn't entirely successful—corrosion continued and plugging, due to sulfides, was still a constant problem.

To control the problem, injection of an organic inhibitor, of the filming amine type,* was started in 1950. This inhibitor was injected as a 2% water solution, being added continually at two points in the system—in the reflux vapor line to protect the lines and



CHEMICAL FEED PUMP which measures out the amount of inhibitor being injected into the system. Because of the small quantities needed, 3-22 ppm, careful proportioning is essential. Operator adjusting valve is William C. Marden, Jr., Sun Oil Co. pumper

The Mechanism of Inhibiting Corrosion

Organic chemical inhibitors of the type used by Sun in the case described here are capable of preventing corrosion because of their filming properties. The nitrogen atoms of the inhibitor molecule are adsorbed on the metal surface to be protected, resulting in a molecularly-thin film or barrier. It is this film which prevents the hydrogen ions (present because of HCl or H_2S dissolved in the water content of the hydrocarbon stream) from attacking the metal.

One important point, according to corrosion engineers, is to get all of the surface exposed to corrosion covered with the film—and to maintain the film. The film is not permanent; it is continually adsorbing and desorbing, and therefore continuous rather than intermittent injection of the inhibitor is usually recommended.

The quantity of inhibitor required is exceedingly small—in the range of 3 ppm (or even less) to 22 ppm, depending on local conditions. The higher concentrations are usually required if exceedingly corrosive conditions are encountered, or if considerably more than 0.1% water is present. The amount will also depend on the pH of a given system—the lower the pH, the greater the amount of inhibitor required.

Because of the small amounts involved, injection is usually in the form of a 5-10% water solution, fed through a chemical proportioning pump.

Corrosion 92%

condensers, and in the reflux return line to protect the column itself. These points are indicated as "A" and "B," respectively, on the diagram. Injection was at the rate of one-half gallon of inhibitor per day (about 2 ppm.) into the reflux vapor line, and 1 gallon per day (3 ppm.) into the reflux return line.

After six months of this treatment the unit was again brought down for inspection. It was found by tray-caliper checks and studies of coupons from the reflux return line that corrosion had been reduced from an initial rate of 0.0219 IPY (inches per year) to 0.0017 IPY—a reduction of 92%.

The tower which in 1949 had only two years' more life is still in service (and with no reduction of operating pressure), and now has a life expectancy in line with normal operations.

On-stream time for the unit has again been lengthened to at least a year, since shutdowns for cleaning fouled equipment are no longer the problem they once were.

Treatment of the unit with the filming amine inhibitor is still being practiced, although at somewhat different rates as determined by experience. About 1 gallon per day of inhibitor is injected into the reflux vapor line (6 ppm) and 1 gallon per day into the reflux return line (1.5 ppm).** Cost of the required inhibitor is estimated by Sun engineers at about $5.50 per day.

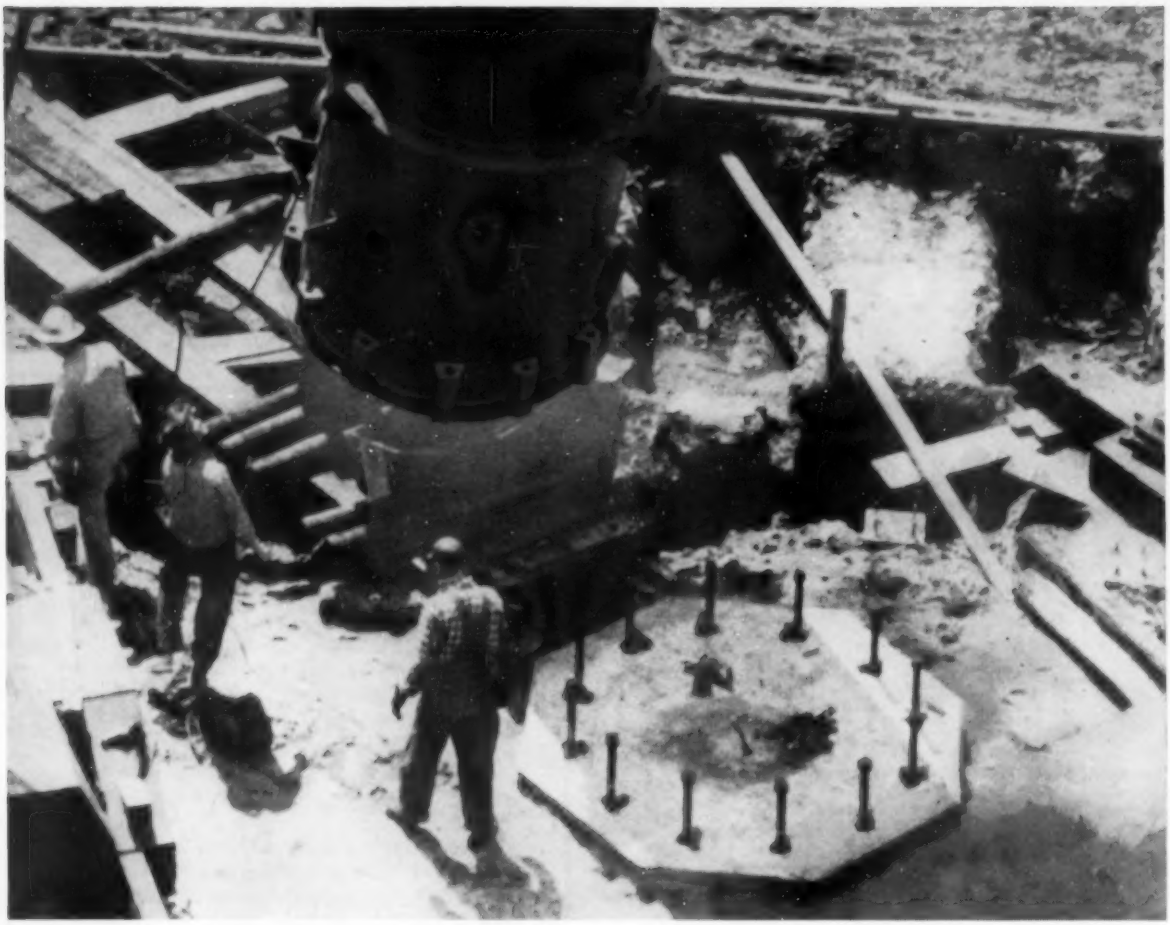
At last reports, consideration was also being given to injection of the inhibitor at a third point—into the liquid feed to the tower (point "C" in the diagram) in order to prevent possible corrosion in the lower section of the tower.

Sun engineers point out, quite properly, that it's not possible to generalize on the results obtainable with corrosion inhibitors of this type. Although they have been able to control corrosion in their deethanizer, a similar unit in another plant might not react in the same manner because of any number of variables.

They do feel, however, that their experience has shown that corrosion isn't something you simply have to put up with, that it isn't necessarily the "nature of the beast," and that there are other ways to control it besides periodically replacing the ravaged equipment.

* Polyrad 1110A (Hercules Powder Co.)

** The apparent discrepancy between these injection rates and the earlier ones (½ gal. = 2 ppm in the reflux vapor line, and 1 gal. = 3 ppm in the reflux return line) is explained by the fact that the feed and reflux rates for the unit are different today from what they were in 1950.



IMPROVED METHOD FOR
Designing Tower Anchorages

Which takes into consideration the elastic properties of the materials

By E. ALFRED PICARDI, Chief Structural Engr.
Kaighin & Hughes, Toledo, Ohio

VARIOUS methods, rules of thumb and standards have been proposed and are presently used in designing anchorage for tall fractionating towers. Anchor bolt tension and the compressive stress on the concrete pedestal at the leeward toe of the base under wind loadings are of primary concern.

Appurtenant anchorage details are usually proportioned and designed on the basis of these stresses.

Many present methods of computation either neglect the elastic properties of the materials and lead to inaccuracies of over-simplification or are set up to be adaptable to bases of simple rectangular shape seldom encountered on these vessels.

The following method is offered as a reasonably rigorous analysis applicable to circular bases commonly employed on tall towers in the petroleum and petrochemical processing field. The method is applicable for the usual conditions where wind load produces tension on the windward anchor bolts.

In the usual design problem of this type the vessel diameter, height and weight are known. The overturning moment due to design specification wind loading is computed and some appropriate base plate diameter is chosen.

If it is assumed that the base plate remains a plane while under stress the vertical displacements of points on the base plate from their original positions are proportional to their respective distances from the neutral axis. It is also assumed that the effective vertical depth of the pedestal is equal to the embedded depth of the anchor bolts.

The forces acting on the base plate on the area in contact with the pedestal may be noted as shown in Fig. 1. If R is the axial load of the tower and M_w the overturning moment at the base due to wind loading, this applied loading may be represented by a single load, R, acting with an eccentricity, $e=M_w/R$. Further, in Fig. 1:

f_c = maximum compression stress in the concrete.
Δl_c = vertical displacement of the tower base at the point of maximum compression in the concrete.
Q = the resultant compression force on the base.
T = the resultant tension force on the tower base exerted by that portion of the anchor bolt group in tension.
Δl_t = the vertical displacement of the tower base at the point of application of the resultant force, T.

From the applied loading, reactions and displacements noted in Fig. 1, three equations may be written as follows:

1—The sum of all vertical forces must be equal to zero:

$$R + T - Q = 0 \quad \text{.....(a)}$$

Or solving for T:

$$T = Q - R \quad \text{.....(1)}$$

2—The sum of the moments of all forces acting on the base must be equal to zero:

$$Q\,(e - s) - T\,(a + e) = 0 \quad \text{.....(b)}$$

Or solving for T:

$$T = Q\,\frac{(e - s)}{(a + e)} \quad \text{.....(2)}$$

3—The base plate remains a plane under stress, therefore the displacements of all points on the base are proportional to their distances to the neutral axis:

$$\frac{\Delta lt}{\Delta l_c} = \frac{a + b}{r - b} \quad \text{.....(c)}$$

Further, by applying Hooke's law we may write Equations d and e:

$$\Delta l_t = \frac{Tl}{E_s A_g} \quad \text{.....(d)}$$

$$\Delta l_c = \frac{f_c l}{E_c} \quad \text{.....(e)}$$

where:

A_g = gross area of steel in anchor bolts in tension.
E_s = modulus of elasticity of steel.
E_c = modulus of elasticity of concrete.

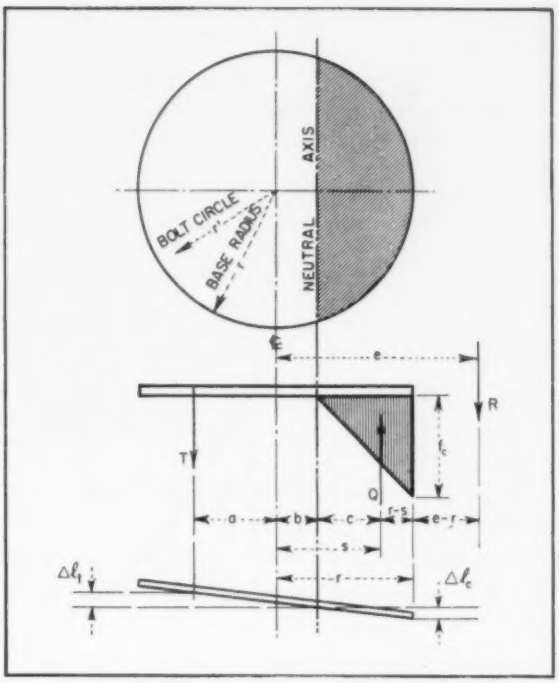


FIG. 1—Forces acting on anchorage base for tall fractionating tower

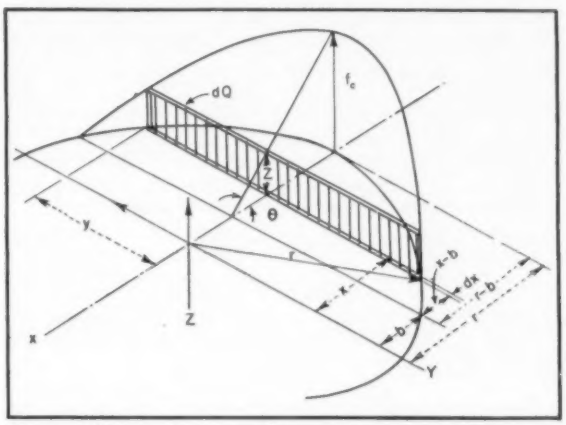


FIG. 2—Diagram for computing resultant compression force

Mr. Picardi

Meet the Author

Mr. E. Alfred Picardi is presently employed as Chief Structural Engineer of Kaighin & Hughes, Inc., Toledo, Ohio. He is a Registered Professional Engineer in Massachusetts and Ohio, and associate member of the American Society of Civil Engineers and a member of the National Society of Professional Engineers. He holds a B.S. degree in Civil Engineering from Massachusetts Institute of Technology.

In his present position and in his former position with E. B. Badger & Sons of Boston, Mr. Picardi has done considerable work in structural design of petroleum processing installations and many chemical and industrial plants. He was in responsible charge of indeterminate structural analysis of the Long Island Viaduct while employed as Structural Engineer for the Crandall Engineering Co. in Boston.

A previous article by Mr. Picardi on "How to Apply Method of Slope Deflection to Thermal Stress Analysis of Piping" appeared in the March 1953 issue of PETROLEUM PROCESSING.

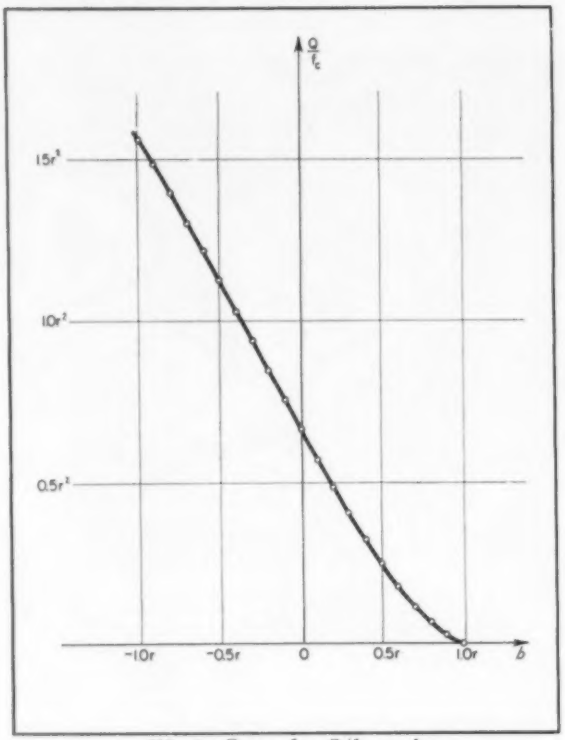


FIG. 3—Curve for Q/f_c vs. b

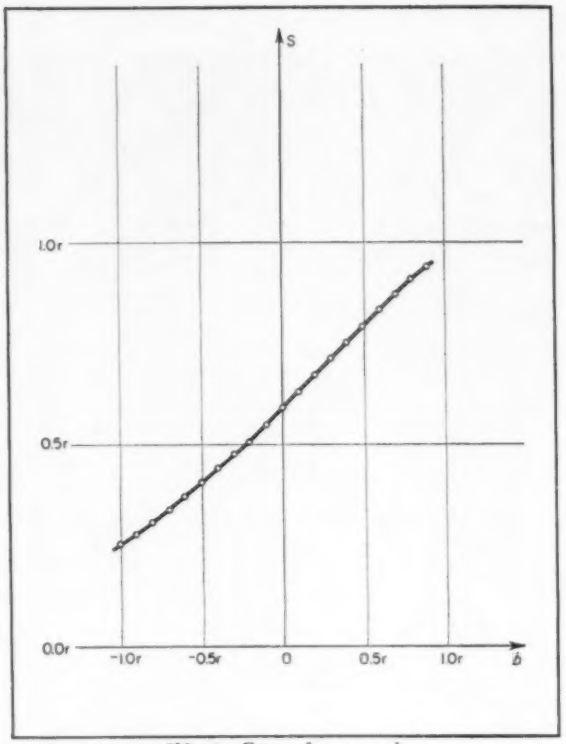


FIG. 4—Curve for s vs. b

Substituting in Equation c values of Δl_t and Δl_c from Equations d and e and $E_s/E_c = n$, this equation becomes:

$$\frac{\frac{Tl}{E_s A_s}}{\frac{f_c l}{E_c}} = \frac{a+b}{r-b} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (f)$$

It may be simplified and solved for T thus:

$$T = f_c A_s n \frac{(a+b)}{(r-b)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The resultant compressive force, Q, is distributed over a portion of the base plate as indicated in Fig. 2. This force is equal to the "volume" between the horizontal and inclined planes and may be expressed as follows:

$$dQ = 2\,y\,z\,dx$$
$$y = \sqrt{r^2 - x^2}$$
$$z = (x-b)\tan\Theta$$
$$\tan\Theta = \frac{f_c}{r-b}$$
$$z = \frac{f_c}{r-b}(x-b)$$

therefore:

$$dQ = \frac{2f_c}{r-b}\sqrt{r^2-x^2}\,(x-b)\,dx$$

$$\int dQ = \frac{2f_c}{r-b}\left[\int_b^r x\sqrt{r^2-x^2}\,dx - b\int_b^r \sqrt{r^2-x^2}\,dx\right]$$

$$Q = \frac{2f_c}{r-b}\left\{-\frac{br^2}{2}\sin^{-1}1 + \frac{1}{3}\sqrt{(r^2-b^2)^3} + \frac{b}{2}\left[b\sqrt{r^2-b^2} + r^2\sin^{-1}\frac{b}{r}\right]\right\} \quad \ldots\ldots (4)$$

This equation is solved for Q/f_c in terms of r^2 for values of $b=kr$ in Table 1, and a curve of $b=kr$ vs. Q/f_c is plotted in Fig. 3. This curve will be used later to facilitate solution of a typical problem.

Table 1—Values for Q/f_c and s in terms of r for various values of $b = kr$*

b	Q/f_c	s
$-1.0r$	$1.5708r^2$	$0.2500r$
$-0.9r$	$1.4799r^2$	$0.2785r$
$-0.8r$	$1.4035r^2$	$0.3061r$
$-0.7r$	$1.3114r^2$	$0.3373r$
$-0.6r$	$1.2238r^2$	$0.3702r$
$-0.5r$	$1.1312r^2$	$0.4043r$
$-0.4r$	$1.0377r^2$	$0.4395r$
$-0.3r$	$0.9440r^2$	$0.4758r$
$-0.2r$	$0.8505r^2$	$0.5128r$
$-0.1r$	$0.7576r^2$	$0.5507r$
$0.0r$	$0.6666r^2$	$0.5891r$
$+0.1r$	$0.5771r^2$	$0.6285r$
$+0.2r$	$0.4905r^2$	$0.6677r$
$+0.3r$	$0.4069r^2$	$0.7079r$
$+0.4r$	$0.3267r^2$	$0.7495r$
$+0.5r$	$0.2520r^2$	$0.7889r$
$+0.6r$	$0.1825r^2$	$0.8308r$
$+0.7r$	$0.1173r^2$	$0.8771r$
$+0.8r$	$0.0660r^2$	$0.9167r$
$+0.9r$	$0.0220r^2$	$0.9375r$
$+1.0r$	$0.0000r^2$	$1.000r$

*Values of Q/f_c were computed from Equation 4 and values of s from Equation 5 by the Office of Statistical Services at the Massachusetts Institute of Technology.

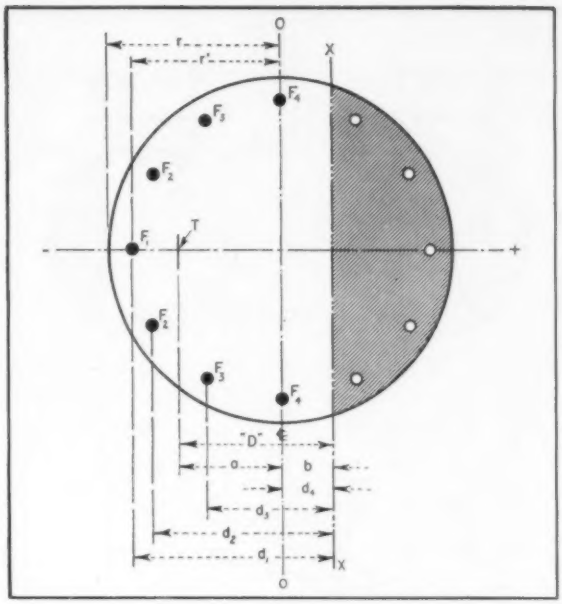


FIG. 5—Diagram for computing values of D

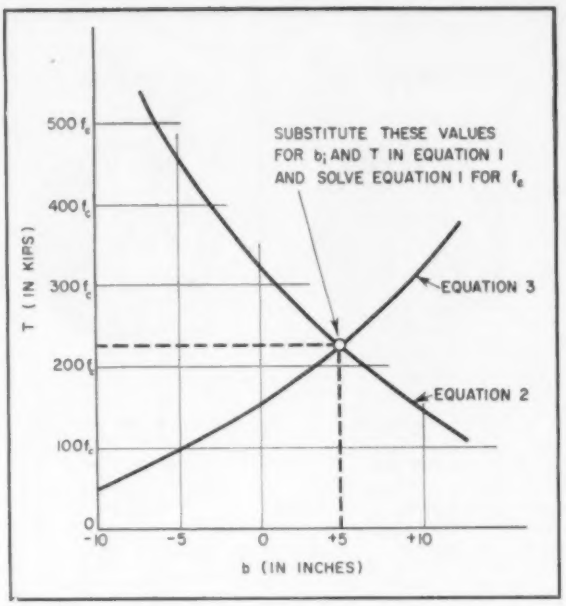


FIG. 6—Typical curves for Equations 2 and 3

In Fig. 1, s represents the distance from the center of the base to the line of action of the resultant force, Q. It may be expressed as follows:

$$s = \frac{\int x dQ}{\int dQ}$$

$$s = \frac{\dfrac{2 f_c}{r - b}\left[{}_b\!\int^{r} x^2 \sqrt{r^2 - x^2}\, dx - b\, {}_b\!\int^{r} x \sqrt{r^2 - x^2}\, dx \right]}{\dfrac{2 f_c}{r - b}\left[{}_b\!\int^{r} x \sqrt{r^2 - x^2}\, dx - b\, {}_b\!\int^{r} \sqrt{r^2 - x^2}\, dx \right]}$$

(NOTE: Equation 5 is at bottom of page.)

Equation 5 is solved for s in terms of r for values of $b = kr$ in Table 1 and a curve of s vs. b is plotted in Fig. 4. The curve will be used later to facilitate solution of a typical problem.

Thus far we have five independent equations, 1, 2, 3, 4 and 5, and seven unknowns, T, Q, S, a, b, A_s and f_c. If we choose a specific trial anchor bolt group and for this group select several trial values of b, the problem can be solved and values for T, f_c and Q can be determined by the following procedure:

Given: the weight of the empty tower, R, radius of base, r, bolt circle raduis, r', and overturning moment due to wind load, M_w.

Procedure: Select some anchor bolt group of some definite number of bolts and their diameter, and assume several trial values of b for this bolt group, Sketch Fig. 5 for each trial value of b, showing the position of the assumed neutral axis, x—x, at the distance b from the center of the base. On Fig. 5 indicate the anchor bolts in tension and their distances from the x—x axis. Assume the load on each bolt to be proportional to its distance to the x—x axis, and compute the distance D from the neutral axis to the center of loads, i.e., the point of application of the resultant tensile force, T.

Plot curves of Equations 2 and 3 for T (in terms of f_c) vs. b, as indicated in Fig. 6. These curves intersect at some value of b and T which satisfies both Equations 2 and 3. If we substitute in Equation 1 the value of T (in terms of f_c) found from the intersection of the curves in Fig. 6 and use b from this intersection point to determine Q in Equation 1 we may then solve Equation 1 for f_c.

Substituting this value of f_c in either Equation 2 or 3 we may then solve for T.

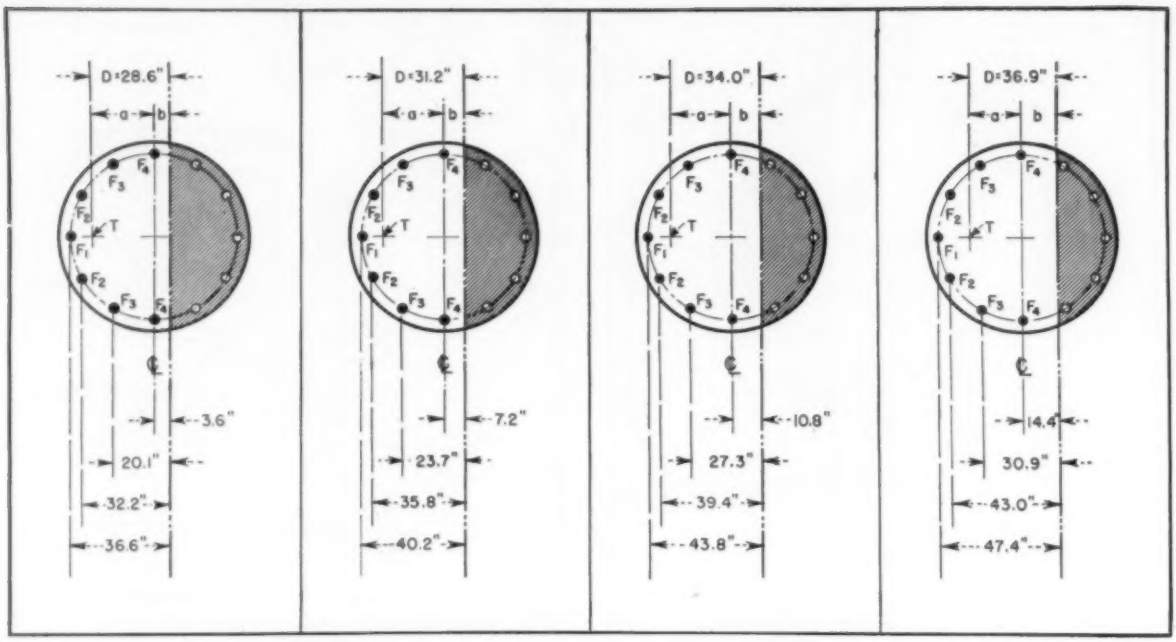
This resultant force, T, may be backfigured to the anchor bolt group assumed originally to determine the maximum load on the most stressed bolt and the unit stress in this bolt, i.e., f_s.

Should f_c or f_s exceed the maximum allowable stress, a new anchor bolt group having more bolts or larger diameters should be chosen and the problem reworked until stresses fall within the allowable.

On the following two pages is given a typical numerical example of a problem similar to those encountered in practice.

$$s = \frac{\dfrac{r^4}{8}\sin^{-1} l + \dfrac{b}{4}\sqrt{(r^2 - b^2)^3} - \dfrac{r^2}{8}\left[b\sqrt{r^2 - b^2} + r^2 \sin^{-1}\dfrac{b}{r} \right] - \dfrac{b}{3}\sqrt{(r^2 - b^2)^3}}{-\dfrac{br^2}{2}\sin^{-1} 1 + \dfrac{1}{3}\sqrt{(r^2 - b^2)^3} + \dfrac{b}{2}\left[b\sqrt{r^2 - b^2} + r^2 \sin^{-1}\dfrac{b}{r} \right]} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

FOR AN EXAMPLE OF HOW TO APPLY THIS METHOD, please turn page ➡



FIGS. A-D—Sketches of four trial values for b, the assumed position of the neutral axis

EXAMPLE OF

How to Apply the Design Method To a Tower Anchorage Problem

Given: A fractionating tower 5 ft.-0 in. in diameter and 100 ft.-0 in. high. The empty tower and its attached platforms and piping weighs 40 kips.* An overturning moment due to wind loading is computed to be 640 ft. kips. A base plate diameter of 6 ft.-0 in. and a bolt circle diameter of 5 ft.-6 in. has been chosen.

Find: the maximum compressive stress in the concrete and the maximum tensile stress in the anchor bolts for an assumed number and size of anchor bolts.

$M_w = 640$ ft. kips
$R = 40$ kips
$e = \frac{M_w}{R} = \frac{640}{40} = 16$ ft. $= 192$ in.
$n = \frac{E_s}{E_c} = 10$
$r = 36$ in.
$r' = 33$ in.

Procedure: Assume an anchor bolt group consisting of 12-2¼ in. ϕ bolts and assume trial values of b as follows:

Trial No.	b
1	$0.1r$— 3.6 in.
2	$0.2r$— 7.2 in.
3	$0.3r$—10.8 in.
4	$0.4r$—14.4 in.

Construct sketches of the base showing for each trial value of b the assumed position of the neutral axis, x-x, at a distance b from the center of the base. Indicate the bolts in tension and their distances to the assumed neutral axis. Assume the load on each bolt proportional to its distance to the neutral axis and compute the position of the center of these loads with respect to the neutral axis.

This is done for each value of b, and the results are indicated in Figs. A through D.

We may now proceed with the plotting of curves of T as a function of f_c vs. b for Equations 2 and 3.

$$T = Q\frac{(e - s)}{(a + e)} \quad \ldots\ldots (2)$$

$$T = f_c A_g\, n\frac{(a + b)}{(r - b)} \quad \ldots\ldots (3)$$

Data for these curves appears in Table A and the curves are plotted in Fig. E.

We note from the intersection of the curves for Equations 2 and 3 in Fig. E that the values $b = 11.5$ and $T = 389\ f_c$ satisfy both equations.

If we use the value $b = 11.5$ to determine the value of Q from Table 1 and substitute this value for Q in Equation 1, and use $T = 389\ f_c$ for T in Equation 1 we may solve this equation for f_c and arrive at solutions for T, f_c and b which satisfy all three equations.

* 1 kip = 1000 lbs.

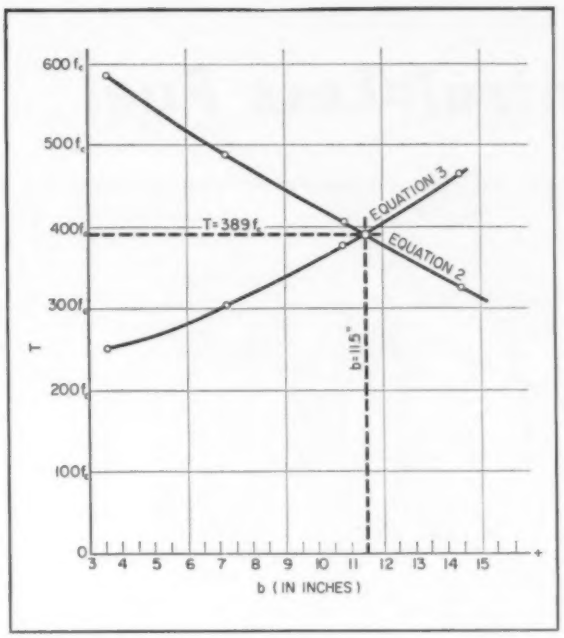


FIG. E—Curves for values of b vs. T computed from Equations 2 and 3

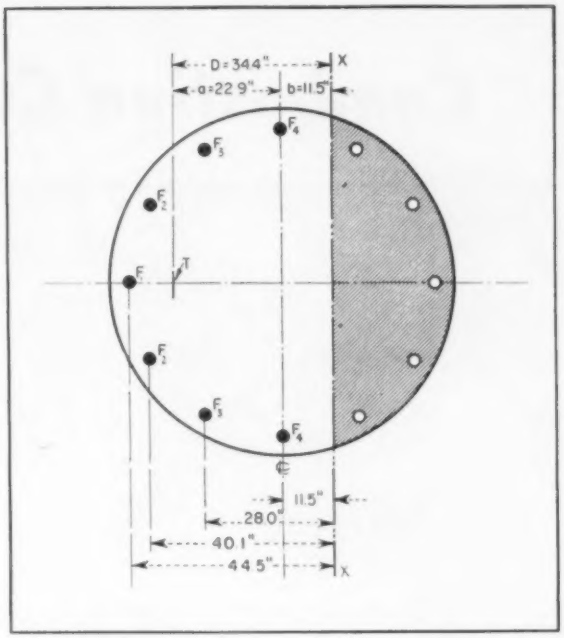


FIG. F—Sketch of base showing final computations

$$T = Q - R \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$
$$380\, f_c = 507.6\, f_c - 40$$
$$f_c = 0.337 \text{ kips/sq. in.}$$
and
$$T = 131.1 \text{ kips}$$

By use of Fig. F and the value for T from Equation 1, we may backfigure the value for F_1, the load on the most stressed bolt, and arrive at f_s, the stress in this bolt, by dividing this load by the area of the bolt at the root of its thread. The computation is as follows:

Assuming the load on each bolt to be proportional to its distance to the neutral axis, we may express the load on each bolt in terms of F_1, the load on the most stressed bolt.

$$\left.\begin{aligned} 1 \times F_1 &= \frac{44.5}{44.5} F_1 = 1.0\, F_1 \\ 2 \times F_2 &= \frac{40.1 \times 2}{44.5} F_1 = 1.8\, F_1 \\ 2 \times F_3 &= \frac{28.0 \times 2}{44.5} F_1 = 1.26\, F_1 \\ 2 \times F_4 &= \frac{11.5 \times 2}{44.5} F_1 = 0.52\, F_1 \end{aligned}\right\} = T = 4.58\, F_1$$

Taking moments about the neutral axis of all loads, we may write the following equation:

$$44.5\, F_1 + 40.1\,(1.8\, F_1) + 28.0\,(1.26\, F_1) + 11.5\,(0.52\, F_1) = 4.58\, F_1\, D$$

Solving for D we get $D = 34.4$ in. Using the value of T computed from Equation 1 ($T = 131.1$ kips) we can solve for

$$F_1 = \frac{T}{4.58} = 28.6 \text{ kips}$$

We assumed 12-2¼ in. ø bolts which each have an area of 3.02 sq. in. at the root of the thread. Thus our maximum anchor bolt stress, f_s, will be:

$$f_s = \frac{28.6 \text{ kips}}{3.02 \text{ sq. in.}} = 9.5 \text{ kips/sq. in.}$$

Smaller bolts may be used if we are willing to tolerate higher stresses. Insofar as A_g, the gross area of anchor bolts in tension, enters the calculations in Equation 3, the problem must be reworked if the value f_s is unsatisfactory.

Table A—Computed data based on four trial values of b, the assumed position of the neutral axis

Trial No.	b inches	e inches	A_g sq. in.	n	r inches	s* inches	Q* kips	a inches	T (Eq. 2) kips	T (Eq. 3) kips
1	3.6	192	27.83	10	36	22.62	747.9f_c	25.0	583.8f_c	245.7f_c
2	7.2	192	27.83	10	36	24.04	635.7f_c	24.0	494.3f_c	301.5f_c
3	10.8	192	27.83	10	36	25.48	527.3f_c	23.2	408.0f_c	375.5f_c
4	14.4	192	27.83	10	36	26.98	423.4f_c	22.5	325.7f_c	466.8f_c

* Values of Q and s are computed from Table 1 for corresponding values of b and r.

Combustion Control=Less Fuel

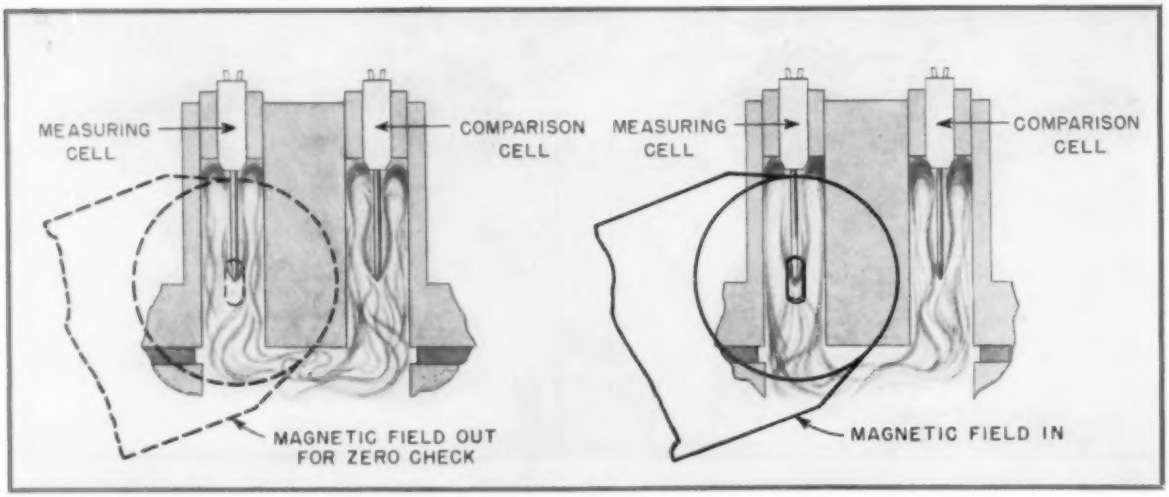


FIG. 1—Principle of operation of oxygen analyzer

THERE'S a chance for substantial savings for you in boosting combustion efficiency in your process heaters and boiler plant. A program started almost five years ago at the East Chicago, Ind., refinery of Socony-Vacuum Oil Co., Inc., aimed at reducing excess air in the flue gases has paid off handsomely.

Annual savings of $32,000 to $34,000 in fuel costs for the entire plant have been estimated as resulting from the combustion efficiency program. For an operating year of 95%, that comes to around $93 to $98 each day.

Success of the program is attributed to four important factors:

1—Management interest and active support.

2—Assignment to one staff engineer of the responsibility for studying combustion, developing methods for improving its efficiency, and seeing that acceptable methods are put into use.

3—Installation of continuous instruments for maintaining closer control of combustion processes.

4—Educating plant operators and obtaining their cooperation in keeping heaters in top operating condition.

The initial cost of approximately $6000 for four oxygen analyzing systems has been paid off many times. In addition, Socony-Vacuum engineers are convinced the instrumentation has helped employes become more aware of still another way to keep costs down.

Prior to the intensified program directed toward higher combustion efficiencies, furnace operation had been checked by visual examination of the flame and the fire box, along with an occasional—perhaps twice a week—Orsat analysis of the flue gases.

By WILLIAM C. UHL
Associate Editor—Equipment

A study of flue gas analyses made at the East Chicago refinery in mid-1949 showed that excess air at unit heaters had been averaging 43%. That represents approximately 6.7% excess oxygen. It was also noted that at certain furnaces, flue gas temperatures became very high toward the end of each onstream period.

A concentrated effort was therefore directed at these two problems to increase combustion efficiency.

Excess air in the flue gas was brought down to an average of 29% (about 4.9% oxygen) within a few months by the establishment of a number of routine practices. Flue gas analyses were made more frequently, and draft and burner adjustments were made on the basis of these analyses. After adjustments, check-up analyses were run. Considerable furnace and burner maintenance was also done to reduce air leaks and improve burner performance. And finally, the oxygen analyzers were installed to provide continuous monitoring.

Flue gas temperatures were decreased by the use of soot-blowing equipment. Chemical methods for removing fire scale were investigated but not used.

Ideal conditions for excess oxygen in the flue gas would be 0%, of course. Optimum percentage, however, is between 3 and 4%, and that's what Socony shoots for. The data in the graph show the amount of fuel that can be saved, in dollars, for a reduction in excess oxygen from 6 to 3.5%, or 2.5 points. The figures from which the chart was derived are based on No. 6 fuel at a refinery price of $1.72/bbl. The curves are not accurate to a high degree, but serve to illustrate possible savings. They were developed by East Chicago's combustion engineer as an educational and promotional tool for the unit operators. They will eventually be made a part of a procedural handbook for operating personnel.

A total of four analyzers are being used at the refinery: one on the polyform unit heater; one on the combination unit heater; one operating on a half-hour time cycle on the crude and the reduced crude heaters of the Thermofor catalytic cracking unit; and one on one of the six boilers in the boiler house.

Operators watch the continuous recorders and keep the excess oxygen in the range of 3 to 4% by taking the following corrective measures:

1—Regulation of the damper.

2—Control of air flow (primary or secondary) at the burner.

3—Checking the pressure in the plenum chamber.

4—Visual inspection of the furnace for possible leaks.

5—Calling on the plant combustion engineer for help and advice.

Principle of operation of the instrument is based on the magnetic property of oxygen.

Oxygen is unique among other common gases in that it is highly para-magnetic—attracted into a magnetic field. The others are slightly dia-magnetic—repelled from a field, except for some of the oxides of nitrogen, NO and NO_2. These are rarely if ever, encountered in industrial gas analysis. Common gases containing oxygen atoms, such as CO_2 and CO do not exhibit a para-magnetism because of molecular arrangement.

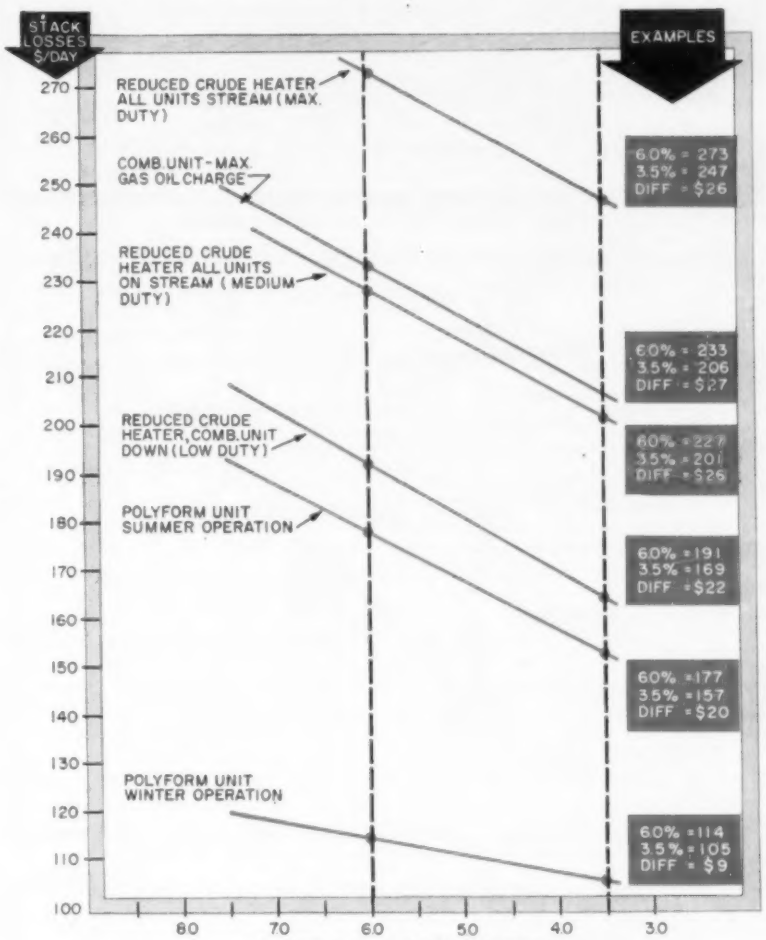
How this fact is used to measure oxygen content is illustrated in the drawings in Fig. 1, a cross section of the sample cell block in the analyzer. The left-hand flow passage in each sketch is the measuring cell: the other is the comparison cell.

Without a magnetic field—as when the magnetic field is "swung away" from the measuring cell for zero check—the two cells are identical. Gas diffuses into both and cools the heated resistor elements equally by means of thermal conduction of the gas and the other paths of heat loss.

During operation of the analyzer, however, with the magnet creating a strong field in the measuring cell only; oxygen-bearing gas is attracted into that cell, where it cools the resistor. In so doing, the oxygen loses its magnetism very rapidly—in proportion to the square of its temperature rise.

The heated, demagnetized gas is moved on out of the magnetic field and upward along the resistor by cooler, more magnetic, oxygen-bearing gas coming in from below. The moving gas continues to absorb heat from the resistor and, in its downward path along the walls, releases heat to the cell block. A continuous flow of the gas sample is thus magnetically induced, causing a flow rate and cooling effect in definite relation to the magnetism of the gas entering the measuring cell.

Cooling both the measuring and comparison cell resistors causes their electrical resistances to be reduced. To isolate and measure only the magnetically induced resistance changes taking place in the measuring cell, the change in resistance of the resistor in the comparison cell is subtracted from the change in resistance of the resistor in the measuring cell in the bridge circuit of the analyzer. The resultant resistance measurement is, therefore, due only to the oxygen content of the gas. The bridge circuit is connected into the network of a recording section where it is amplified, indicated, and recorded.



STACK LOSSES GO DOWN when excess oxygen in flue gas goes down

There is no problem with distance between analyzer and recorder, since the connections are all electrical circuitry. Explosion-proof construction is used throughout at East Chicago. The power is 20 volts A. C., 60 cycle. Two arms of the bridge are in the analyzer and the other two are in the recorder.

Proper sampling is probably the single most important factor in the successful operation of the oxygen analyzing equipment. Socony uses two arrangements: a steam-actuated aspirator and a differential bubbler.

The steam-operated "Gaspirator" operates essentially like any aspirating device. It is shown schematically in Fig. 2, with another schematic in Fig. 3 illustrating the entire "Gaspirator" sampling assembly. Steam flows out to the end of the sampling inlet tube and then passes back through the inside tube.

An illustration of the differential bubbler, the second type of sampling device Socony uses, is shown in Fig. 4, and a schematic of how it is installed is in Fig. 5. Both types of

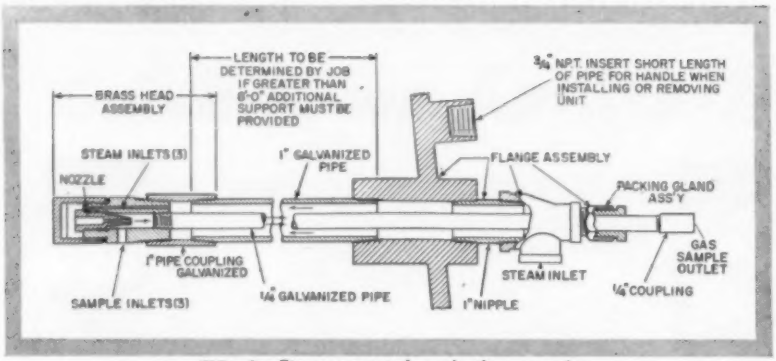

LENGTH TO BE DETERMINED BY JOB IF GREATER THAN 6'-0" ADDITIONAL SUPPORT MUST BE PROVIDED
BRASS HEAD ASSEMBLY
STEAM INLETS (3)
NOZZLE
1" GALVANIZED PIPE
3/4" N.P.T. INSERT SHORT LENGTH OF PIPE FOR HANDLE WHEN INSTALLING OR REMOVING UNIT
FLANGE ASSEMBLY
PACKING GLAND ASS'Y
GAS SAMPLE OUTLET
1/4" COUPLING
1" PIPE COUPLING GALVANIZED
SAMPLE INLETS (3)
1/4" GALVANIZED PIPE
STEAM INLET
1" NIPPLE

FIG. 2—Steam-operated aspirating sampler

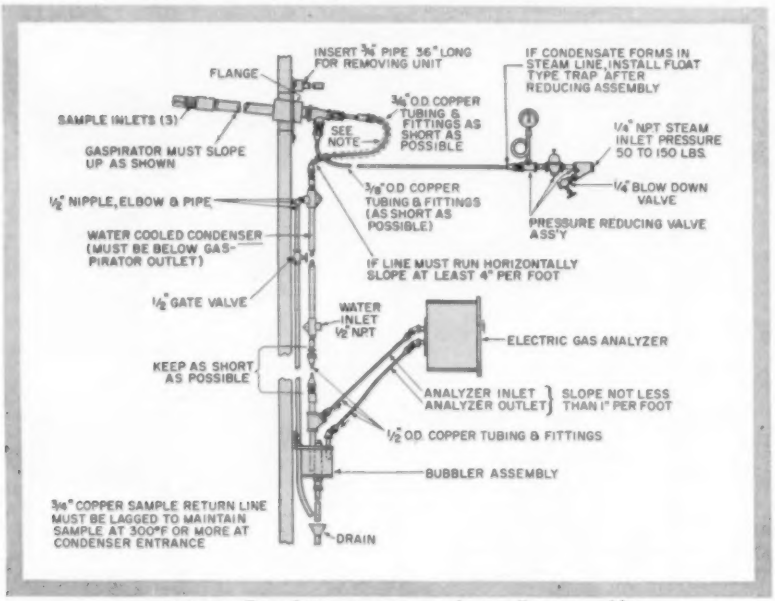

INSERT 3/4" PIPE 36" LONG FOR REMOVING UNIT
IF CONDENSATE FORMS IN STEAM LINE, INSTALL FLOAT TYPE TRAP AFTER REDUCING ASSEMBLY
FLANGE
SAMPLE INLETS (3)
3/8" O.D. COPPER TUBING & FITTINGS AS SHORT AS POSSIBLE
SEE NOTE
GASPIRATOR MUST SLOPE UP AS SHOWN
1/4" N.P.T. STEAM INLET PRESSURE 50 TO 150 LBS.
1/4" BLOW DOWN VALVE
1/2" NIPPLE, ELBOW & PIPE
3/8" O.D. COPPER TUBING & FITTINGS (AS SHORT AS POSSIBLE)
PRESSURE REDUCING VALVE ASS'Y
WATER COOLED CONDENSER (MUST BE BELOW GASPIRATOR OUTLET)
IF LINE MUST RUN HORIZONTALLY SLOPE AT LEAST 4" PER FOOT
1/2" GATE VALVE
WATER INLET 1/2" NPT
ELECTRIC GAS ANALYZER
KEEP AS SHORT AS POSSIBLE
ANALYZER INLET
ANALYZER OUTLET
SLOPE NOT LESS THAN 1" PER FOOT
1/2" O.D. COPPER TUBING & FITTINGS
BUBBLER ASSEMBLY
3/8" COPPER SAMPLE RETURN LINE MUST BE LAGGED TO MAINTAIN SAMPLE AT 300°F OR MORE AT CONDENSER ENTRANCE
DRAIN

FIG. 3—Complete steam-operated sampling assembly

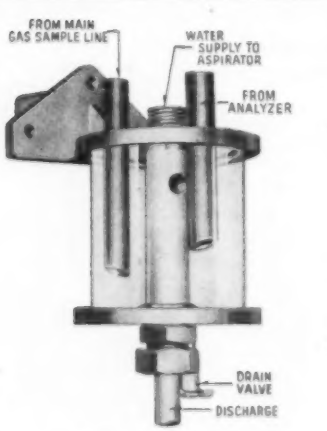


FIG. 4—Differential bubbler, above

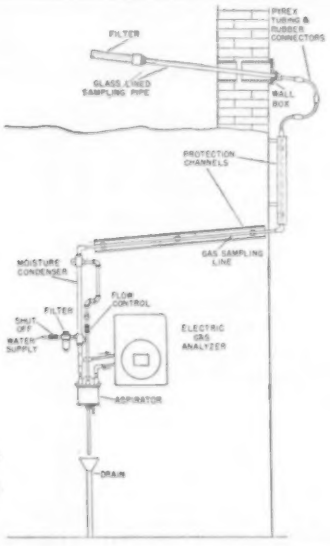


FIG. 5—Right, how the bubbler is installed

samplers provide flow of sample gas to the analyzer at a controlled rate, and at controlled temperature (by means of the water-cooled condenser).

Maintenance costs are very low. Socony estimates they will run about 20% higher than on a conventional flow controller. None of the analyzers have had to be overhauled since being installed almost five years ago. The electrical connections and electronic components receive a check-up once every three months. The recorders are calibrated with an Orsat apparatus once a week and occasionally by running them on a known sample.

Analyzer cells have been no prob lem; although there were some "bugs" that had to be worked out in the beginning of the program. Socony keeps one spare cell on hand at all times for all four instruments. It is anticipated that cell replacement will come up once every two years.

A final answer to corrosion has not yet been reached. Materials of construction for the sample lines include black iron, stainless steel, Saran, and some glass. Each has presented some problems. The black iron produces iron particles, which get into the sample flow. With the stainless steel, condensate will occasionally cut a deep groove in the line and eventually split the pipe apart. Saran is weak mechanically and is subject to failure at the joints. Glass is difficult to join and subject to breakage from vibration.

One solution seen as a possibility by Socony may well be a copper or an aluminum line with an interior lining of a plastic material.

Success of the overall program for improving combustion efficiency was best summed up by the combustion engineer at East Chicago, when he told us how it has helped make the operators more conscious of the losses that had been going on and the savings he as an operator could effect.

"Before the oxygen recorders were installed, the operators fired their furnaces by 'sight.' They would argue with the foreman when he would tell them to make adjustments because the Orsat analysis had shown too much air in the flue gas. They'd say, 'Hell, the engineer doesn't know. That fire **looks perfect.**' And maybe the fire did look good."

"But now, the operator has something to get a hold of, a chart reading on the oxygen content, just like his other recorders—flow, temperature, or pressure. And, he understands that he has to keep that unit 'in line.' He's been trained to do that."

How to Handle Chemicals Safely

API medical group prepares data reports on 31 more toxic materials: reviews now total 63

By V. B. GUTHRIE
Associate Editor

THE needs of petrochemical plants and refineries making materials used in chemical manufacturing are covered in the set of Toxicological Reviews recently published by the API Medical Advisory Committee.

This latest series includes 31 new substances ranging from acetic acid to triethanolamine, most of them produced or used in the chemical extraction phase of petroleum refining and in the further manufacture of synthetic rubber, fertilizers, plastics, solvents, and so on.

The current series is an addition to the two issued in 1948. With them, the API Department of Technical Services now has available Toxicological Reviews on 63 substances. The earlier 32 reviews covered some of the straight petroleum products and the chemicals used in processing and treating them. Table 1 lists the current reviews. Previous articles in PETROLEUM PROCESSING reported on the earlier reviews.[1,2]

The Toxicological Reviews are planned by the API Committee, made up of 28 doctors of medicine with oil companies. Chairman is Dr. George M. Saunders, Socony-Vacuum Oil Co., Inc., New York. The reviews are prepared at the Harvard School of Public Health, under the direction of the well known authority, Prof. Philip Drinker.

Each review is organized along the same line. The first section presents the data necessary to identify the individual substance, while the second section presents its general physical and chemical properties. Characteristics influencing volatility are emphasized, as these have a marked influence on the degree of atmospheric exposure which is likely to occur.

Where sufficient information is available, this section is divided into general considerations, including information on metabolism and excretions; acute effects, chronic effects and, finally, safe limits of exposure for an 8-hr. period, 5 days a week.

Another section provides the available information on the treatment of poisoning by the substance under consideration, with specific therapeutic measures emphasized. Preplacement, or periodic, examinations are recommended for workers likely to be required to undergo significant exposure to certain toxic substances. The special tests or examinations are given which are advised for the particular substance reviewed.

Each review then discusses the precautionary measures, both mechanical and personal, which are recommended for handling the particular substance. The final section of each review is a selected bibliography documenting the information given in the preceding sections.

Important features of a few of the current toxicological reviews are given below:

Aromatic Solvent Naphtha

Products called solvent naphtha consist mainly of the xylenes, ethyl benzene, cumene and perhaps some toluene. The presence of traces of benzene cannot be ruled out. Products now made from virgin petroleum naphthas of high aromatic content, must be classed as solvent naphthas with the coal-tar distillates.

The various boiling ranges of the aromatic naphthas introduces difficulties into their toxicological evaluation.

A concentration of 200 ppm. has been set as the maximum allowable for coal-tar naphtha. It would be good practice if the maximum allowable should be considered 100 if the product includes any appreciable distillate percentage between the boiling points of benzene and toluene, and 200 if the major portion of the naphtha has a boiling point above that of toluene (230.9° F.).

Technical DDT

The toxicity of dry crystalline DDT is of restricted interest, because when it is in the dry powdered form, the substance is absorbed through the skin only when the skin is oily. Even in industry, the material is commonly encountered in other forms, where the problem is complicated by the varying toxicities of the various solvents used, so that the ease of absorption of DDT may be increased.

Because oily skin enhances the absorption of DDT, care should be taken to keep the skin of workers free from grease, oils and greasy skin lotions. Skin contact should be avoided, both to prevent skin absorption and to keep DDT from being carried to the mouth. Workers likely to exposure for pro-

How to Get the Reviews

Copies of the 63 separate API Toxicological Reviews are available individually at 25¢ each, and in groups, complete sets, and volume lots at special prices. For information, write to: Department of Technical Services, American Petroleum Institute, 50 West 50th St., New York 20, N. Y.

Toxic substances covered by the earlier reviews, in addition to those in Nos. 33 through 63, shown here in Table 1, are:

1—Aluminum Chloride.
2—Boron Trifluoride.
3—B, B' Dichloroethyl Ether.
4—Cresol.
5—Cumene.
6—Furfural.
7—Hydrogen Chloride.
8—Hydrogen Sulfide.
9—Iron Carbonyl.
10—Nitrobenzene.
11—Styrene.
12—Sulfuric Acid.
13—Toluene.
14—Xylene.
15—Acrylonitrile.
16—Alkyl Disulfides.
17—Alkyl Mercaptans.
18—Ammonia.
19—Benzene.
20—Carbon Tetrachloride.
21—Diethylene Glycol.
22—Dowtherm A.
23—Kerosine.
24—Mercury.
25—Methyl Ethyl Ketone.
26—Morpholine.
27—Naphthenic Acids.
28—n-Butyl para-amino phenol.
29—Phenol.
30—Phosphorus Pentasulfide.
31—Sulfur Dioxide.
32—Thiophene.

Table 1—Toxicological Properties of Chemicals Handled in Petrochemical and Refining Plants

No.	Chemical	Perm. Conc. 8-hr. period	Handling Precautions
33	Acetic Acid CH_3COOH	10 ppm.	Adequate ventilation. Avoid direct contact with concentrated acid. Use goggles.
34	Acetone $(CH_3)_2CO$	500 ppm.	Handle in closed systems with adequate ventilation. Use gloves to protect from contact.
35	Ammonium Molybdate $(NH_4)_2MoO_4$	———	Prevent inhalation of dusts carrying large amounts.
36	Ammonium Nitrate NH_4NO_3	———	Use suitable exhaust ventilation.
37	Amyl Acetate $CH_3COO(CH_2)_2CH(CH_3)_2$	200 ppm.	Adequate ventilation. Use gloves to avoid contact.
38	Aromatic Solvent Naphtha (Xylene, $C_6H_4(CH_3)_2$)	200 ppm.	Adequate ventilation, or use chemical respirators in areas of high concentration. Use protective clothing and gloves to avoid contact.
39	Beta-Naphthol $C_{10}H_7OH$	———	Avoid skin contact, inhalation, and ingestion.
40	Butadiene $CH_2:CH\cdot CH:CH_2$	1000 ppm.	Adequate exhaust ventilation.
41	Butyl Acetate $CH_3COOC_4H_9$	200 ppm.	Ventilation, gloves, if exposure is prolonged.
42	Carbon Monoxide CO	100 ppm.	Exhaust ventilation. Test atmosphere for excessive exposure.
43	Copper Naphthenate	———	Avoid prolonged skin contact.
44	Cyclohexane C_6H_{12}	400 ppm.	Ventilation should be adequate and protection from skin contact.
45	"DDT" $CH(C_6H_4Cl)_2CCl_3$	———	Avoid skin contact. Use respirators where exposure to high concentrations is prolonged.
46	Ditertiary Butyl Para Cresol $CH_3C_6H_2(C(CH_3)_3)_2OH$	———	No special precautions needed.
47	Hydrogen Fluoride HF or H_2F_2	3 ppm.	Handle in enclosed systems. Clothing and masks for full protection against skin contact and inhalation.
48	Hydroquinone $C_6H_4(OH)_2$	———	Ventilation or local exhaust. Protective clothing, especially for eyes where handled in large quantities.
49	Maleic Anhydride $C_4H_2O_3$	———	Adequate protection against skin and eye contact.
50	Mesitylene C_9H_{12}	35 ppm.	Ventilation to insure air concentration of 35 ppm. or less. Gloves.
51	Methyl Alcohol CH_3OH	200 ppm.	Label containers poison. Warn against ingestion. Ventilation or respirators where concentration is over 200 ppm.
52	Methylcyclohexane $CH_3C_6H_{11}$	500 ppm.	Adequate general ventilation. Avoid skin contact.
53	Naphthalene $C_{10}H_8$	———	Exhaust ventilation or respirators against inhalation. Avoid skin contact.
54	Nickel Carbonyl $Ni(CO)_4$	1 ppm.	Enclosed handling. Masks and protective clothing for contaminated atmospheres.
55	N:N'-d-secondary Butyl-Para-Phenylenediamine $C_6H_4NH_2N(C_4H_9)_2$	———	Transfer in closed systems. Avoid skin contact. Wear goggles and gloves when handling open containers.
56	Phenylalphanaphthylamine Phenylbetanaphthylamine $C_{10}H_7NHC_6H_5$	———	Avoid dust evolution. Frequent clothing change to combat dermatitis.
57	Phosphoric Acids H_3PO_4	———	Handle in totally enclosed systems. Exposed workers should wear goggles, gloves, and boots.
58	Propyl Alcohols $CH_3\cdot CH_2\cdot CH_2OH$	400 ppm.	Adequate ventilation, particularly where the alcohols are used hot.
59	Pyridine C_5H_5N	———	Ventilation. Wear gloves when handling.
60	Silica SiO_2	———	Design and engineering control, and protective equipment.
61	Thiophenol and Aromatic Mercaptans C_6H_5SH	———	No information available.
62	Trichloroethylene $ClCH:CCl_2$	100 ppm.	Adequate ventilation or use respirators. Avoid skin contact.
63	Triethanolamine $(C_2H_4)H)_3N$	———	Avoid prolonged skin contact with concentrated solutions.

longed periods to relatively high concentrations should wear respirators.

Carbon Monoxide

Probably the most important industrial poison known, from the point of view of number of poisonings encountered. Exposure is usually unexpected and unpredictable, so that special pre-employment examinations cannot be laid down. Periodic examination of exposed workers should be unnecessary, as no chronic effects are to be expected.

The prime safety precaution is maintenance of a concentration of less than 100 ppm. in the air breathed by workers. This can be done by proper venting of exhausts containing carbon monoxide, adequate general and local ventilation and frequent monitoring of the atmosphere to detect excessive exposure. Concentration can be determined by a variety of methods.

Hydrogen Fluoride

Any contact, however slight, will lead to serious consequences unless given immediate attention. Therefore, all workers should be instructed in the importance of treating all contact with hydrogen fluoride as a serious matter, even when no pain is present. Plant physicians should be well acquainted with the proper therapy of fluorine casualties. Workers with serious organic diseases or with abnormal bone or joint conditions should be excluded from work with hydrogen fluoride.

Silica

Two kinds of safety precautions are generally employed in controlling exposure to silica dust—proper engineering and design control, and the use of protective equipment. The exact type of safety precautions can be determined only after detailed study of existing conditions. In general, design and engineering control should provide:

1—Segregation of dust-producing operations.

2—Adequate ventilation to collect dust at its source.

3—Good housekeeping.

4—Elimination or reduction of dust production at its source, by wetting down or use of wet processes.

References

(1) "Toxic Properties of Refining Chemicals Listed by API Medical Committee," Petroleum Processing, Oct., 1948, pg. 969.

(2) "API Medical Group Presents Study of 18 Toxic Refining Chemicals," Petroleum Processing, Oct., 1949, pg. 1094.

Compressor Efficiency Hits Peak—98.96% onstream—when you rack up a maintenance record like this one

	Downtime in Hours, 1953										Total Hours	% Total Down Time	% Down Time
	1	2	3	4	5	6	7	8	9	10			
ENGINES													
Lube Oil System	...	7.5	2.5	9.75	...	5.25	4.00	18.5	11.75	5.25	64.5	5.73	0.07
Jacket Cooling	0.25	0.25	0.25	1.25	0.25	...	...	...	...	...	2.25	0.20	0.0
Fuel System	0.5	0.5	0.75	1.0	0.75	1.25	4.5	0.75	2.0	4.0	16.0	1.42	0.02
Ignition System	0.5	2.0	1.5	5.0	3.25	1.0	6.75	2.0	2.5	4.75	29.25	2.60	0.03
Scavenging	8.5	13.25	4.25	3.25	1.0	0.75	0.75	0.5	2.75	7.5	42.5	3.78	0.05
Cleaning Ports	0.75	1.25	1.5	2.75	...	3.5	5.25	2.5	2.75	3.5	23.75	2.11	0.03
Rings	7.25	...	...	...	...	7.75	3.75	3.75	1.0	4.75	28.25	2.51	0.03
Tune-up	9.25	9.75	11.0	12.5	9.5	11.75	13.5	6.75	6.25	9.75	100.0	8.89	0.12
Piston Heads	7.25	8.75	6.5	8.5	35.0	22.0	24.25	48.5	38.75	6.5	206.0	18.32	0.24
Governors	...	...	2.5	...	0.5	...	1.25	...	1.0	...	5.25	0.47	0.01
Instruments	...	...	...	...	...	...	0.25	...	0.25	1.0	1.5	0.13	0.0
Gaskets	...	...	...	2.5	...	...	...	1.25	0.25	...	4.0	0.36	0.0
Overhaul	44.75	41.25	40.5	52.5	46.0	39.0	...	...	...	...	264.0	23.48	0.30
Pistons	...	...	...	...	...	17.25	...	...	...	...	17.25	1.53	0.02
Cylinders	...	...	0.25	...	...	17.25	23.0	...	...	33.0	73.5	6.53	0.08
Inspection	4.5	...	...	0.25	...	4.5	0.5	...	...	...	9.25	0.87	0.01
Plant (Shutdown)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	0.89	0.01
Air Filter	...	...	...	...	...	...	1.5	1.0	...	...	2.5	0.22	0.0
Misc.	...	1.25	1.5	2.25	1.25	1.75	1.25	1.0	2.0	1.25	13.5	1.20	0.02
COMPRESSORS													
Packing	...	...	...	...	...	...	3.5	...	5.0	...	8.5	0.76	0.01
Jacket Cooling	...	...	...	...	...	...	...	3.0	...	...	3.0	0.27	0.0
Rods	...	...	...	...	...	...	14.0	...	7.75	...	21.75	1.93	0.02
Magnafluxing	5.25	5.5	6.5	3.75	4.75	5.25	4.00	3.25	3.75	5.5	47.5	4.22	0.05
Valves	6.5	6.0	3.75	5.25	10.0	7.25	9.25	16.75	5.0	13.25	83.0	7.38	0.09
Gaskets	...	...	...	...	...	...	...	...	9.0	...	9.0	0.80	0.01
Cross Heads	...	9.75	...	...	...	...	...	...	...	...	9.75	0.87	0.01
Clearance Pockets	1.5	...	...	0.5	...	...	...	...	...	...	2.0	0.10	0.0
Overhaul	8.5	...	...	...	...	...	...	6.75	7.25	...	22.5	2.0	0.03
Miscellaneous	...	...	...	...	...	0.25	1.5	1.0	0.75	0.5	4.0	0.35	0.0
Total, Engines & Compressors	106.25	108.0	84.25	112.0	113.25	146.75	123.75	118.25	110.75	101.5	1124.75	100.00	1.26
RECAPITULATION													
% Downtime, Engine	0.10	0.10	0.09	0.12	0.11	0.15	0.10	0.10	0.08	0.09			1.04
% Downtime, Compressor	0.02	0.02	0.01	0.01	0.02	0.01	0.03	0.04	0.04	0.02			0.22
Total	0.12	0.12	0.10	0.13	0.13	0.16	0.13	0.14	0.12	0.11			1.26

Cheaper Compressor Maintenance?

. . . Follow this three-point program

THE power end of a gas engine-driven compressor can be kept in good mechanical condition with 1% or less downtime. This can be done on a 1600-hp., 8-cylinder engine with 50 or less man-hours of labor per month, including inspection, minor repairs, and overhauls.

Here's a successful, three-point program which cut downtime from 4.7 to 1.04% on an installation of ten, 1600-hp., 8-cylinder, two-cycle engines;

1—Preventive maintenance.
2—Engine repair & overhaul.
3—Material selection and life.

Engine-driven compressors constitute one of the largest single investments in a natural gasoline plant. Anything which decreases the cost of repairs or reduces downtime for maintenance means money to the plant operator.

An estimated investment of $3,500,000,000 for compressors is represented in a 50,000,000 cfd plant designed to compress gas from 5 to 700 psig. There probably will be 10 units handling about 5,000,000 cfd of gas each. Assuming the plant extracts 3 gal. of liquids per 1000 cf., the total gross income per compressor (including residue gas sales) will approximate $1000 /day, or about $42/hr.

The net profit is not so large, and it is greatly affected by on-stream time. Such a plant may have to process 35,000,000 to 40,000,000 cfd to pay operating expenses and retire the investment in 20 years. Just a 5% downtime on compressors, or the equivalent loss in gas-handling capacity through mechanical inefficiency, could reduce plant profits by as much as 25%. Reducing maintenance expense is therefore immediately reflected in plant profits because it reduces operating costs.

How well the three-point program works is illustrated graphically in the downtime chart above. Note particularly the column on "% downtime." This record of operations in 1953 compares significantly with four years ago when "% downtime" was 4.7%. An even more impressive comparison

can be made with the records of 1933. At that time, man-hours of maintenance averaged 500/month, including the bi-annual overhaul. In 1953, the average was less than 100/month.

1. Preventive Maintenance

The target of this minor work done between overhauls is to minimize unit downtime and overall maintenance and operating expense. Operating personnel should set up a preventive maintenance program before a new compressor plant is ever placed in operation.

Routine to be followed will depend to some extent on the types of engines used. The practices described below will apply to most two-cycle engines. Power cylinders are probably the most important and will be covered first.

The ignition system is the heart of an engine. It should be kept in as nearly perfect condition as is possible. Magnetos should be reconditioned in a reputable shop once annually—preferably every six months. Coils likewise should be checked every year. Spark plugs should be replaced with reconditioned, tested plugs periodically—the period between change-outs depending on the type of plug used and operating conditions. Certain plugs can be operated 10 weeks or more and give good engine performance.

Scavenging air compressor suction and discharge valves may fail. The air is usually pulled through a filter which may become restricted. Scavenging air ports may become plugged by carbon deposits.

It is desirable to install a mercury manometer on the discharge of the scavenging air compressor on each engine to prevent maintenance which may result from an air shortage due to any of the above three causes. A high pressure will indicate carbon in the power cylinder ports. Low pressures indicate a failure in the air compressor or the filter. Pressures should be recorded about once each shift, so that normal pressures can be established and unusual conditions spotted.

Fuel injection is by means of a valve that opens a fixed distance. The amount is controlled by the pressure on the fuel manifold which, in turn, is controlled by the main fuel valve operated by the governor. The governor opens the fuel valve wider as the load increases on the engine, causing a higher pressure on the manifold, forcing more fuel into the cylinder through the fixed opening of the injection valve.

A mercury manometer is also recommended for installation on each engine downstream of the governor valve as an aid in checking engine performance. Operators will soon learn to associate the fuel pressure with the gas load being handled, and the manometer gives a visual means of determining whether or not fuel valves are set at the proper clearance.

Excessive clearance on these fuel valves will result in a high fuel pressure and may reach the point where the unit will not handle the gas load at rated speed. Too much valve clearance also causes excessive pounding on the fuel injection valve and seat, resulting in decreased service life.

The load is balanced when the engine is first placed in operation, by using an engine indicator in conjunction with pyrometers on each cylinder to so adjust fuel and air to the individual cylinders that each develops the same horsepower for any given load. When properly balanced by this method, the pyrometer reading on each cylinder will be approximately the same.

Since the air charge in the cylinder does not vary with the load, the cylinder exhaust temperature is used—in effect—to determine the fuel-air ratio. The more fuel burned in the fixed volume of air, the higher the temperature.

After the engine is balanced with the indicator, common practice is to keep the exhaust temperature on the various cylinders approximately the same as indicated on the pyrometers. However, under continuous operation at or near full load, frequent checks are desirable.

The best practice is to balance frequently the peak pressures on the cylinders with an engine indicator. This will give more assurance that each cylinder is carrying its share of the load. If the exhaust temperature on some of the cylinders is high, the cause should be found and removed. If the ignition system is good, and the spark properly timed, the cylinder air ports probably are becoming restricted with carbon and need cleaning.

The periodic "tune-up" is another important part of a preventive maintenance program. Earlier it was stated that spark plugs should be replaced periodically with reconditioned plugs. This should be scheduled along with other "tune-up" practices to distribute uniformly the work from week to week.

The "tune-up" should include testing of all shutdown devices, inspection of magneto points, changing spark plugs, checking ignition timing and checking all other equipment and devices which serve an important function in the operation of the engine. A record of these tests and the operating conditions should be made for use in following the condition of the unit.

The periodic "tune-up" is beneficial in two ways. Assume, for example, that a station has 10 engines and it is planned that every engine will be checked every 10 weeks of operation.

If all engines were checked at one time at the end of 10 weeks, all the engines would be approaching a condition where minor difficulties, such as with ignition, could reasonably be expected. It would be possible to have the whole station go down in event of an overload. In addition, it is possible that other, unanticipated work could arise to make it impossible to check the engines as scheduled.

On the other hand, if one engine is "tuned up" each week, all others should be in better condition than the one being "tuned." Also, only a small amount of work is required each week. If it is necessary to postpone "tuning" one engine for a time, very little loss in efficiency can occur.

2. Engine Repair and Overhaul

Here is a procedure that has cut labor time by 58%. Prior to its adoption, the overhaul of the power end of an 8-cylinder engine required approximately 475 man-hours. At present the same engine is being overhauled in about 200 man-hours.

This decrease in labor and the accompanying reduction of downtime is due primarily to the coordination of the maintenance crews. In addition, several time-saving devices are now being employed in the overhaul.

Coordination of crews works out along these lines. Three crews of four men each are used, so that work can continue 24 hrs./day. Over-all downtime from the overhaul amounts to about 48 hours, or six shifts. A breakdown of each shift follows (numbered consecutively by shift):

1—Remove cylinder heads, coils, spark plugs, fuel injection valves, crankcase doors and covers. Check wrist pin clearances. Remove connecting rod bearings, and pull and rack power pistons.

2—Inspect and re-install main bearings. Clean carbon from ring lands on pistons and fit with new rings.

3—Continue with same assignment as previous shift.

4—Inspect and adjust compressor and scavenger connecting rod bearings. Clean jacket water connections. Clean carbon from air intake ports.

"Mike" pistons and cylinders, and run "glaze buster" on cylinders.

5—Install pistons in cylinders. Adjust connecting rod bearings and start assembling top part of unit.

6—Complete reassembly of unit. Clean crankcase. Start unit and begin moving overhaul platforms, etc., to the next unit to be overhauled.

Time-saving devices employed include the following items:

1—A portable scaffold, four feet wide and the length of the catwalk, fabricated for installation outboard of the catwalk. Cylinder heads and other parts dismantled from that part of the engine are stored on this platform, eliminating the need for lowering them to the floor.

2—Especially fabricated piston racks to provide a convenient and safe place to work on pistons.

3—Air-operated impact wrenches, used to remove practically all nuts and bolts from the engine during dismantling, and to tighten them during reassembly. An air piping manifold with five connecting points is used, making it possible to operate several wrenches at the same time.

4—A portable, explosion-proof, electric motor-driven gear pump, equipped with suction and discharge hoses, for pumping the crankcase oil from the unit into barrels for storage during the overhaul.

5—An air hoist capable of lifting one ton at the rate of 17 ft./min., for pulling and replacing power pistons. Use of this in place of an 8-ton, chain-operated hoist originally provided has resulted in saving 36 man-hours and 11 hours of compressor downtime. The chain hoist required three men a total of 40 man-hours to do the job done now by two men in four man-hours.

6—Main bearing cap hangers, fabricated to make it unnecessary to remove the heavy bearing caps from the crankcase.

7—A method of removing the main bearing lower shell for inspection and replacement. A section of 2 x 8-in. channel iron was cut to fit the lower part of the crankcase, under the crankshaft. It is used as a support for a hydraulic jack employed to lift the crankshaft off the lower main bearing shell.

During the lifting operation, a dial indicator is attached to a bridge installed over the crankshaft and is used to determine the exact height of the shaft during jacking. After the shaft is raised approximately 0.002 in., the lower bearing shell can be rotated readily. A flexible steel cable, with a "tee" handle on one end and a small bolt with a removable lug on the other, is used for removing the bearing shell.

8—Piston wrist-pin clearances are checked by clamping a dial indicator to a "C" clamp attached to the connecting rod, and contacting the piston skirt. The piston is raised with a chain hoist while in the cylinder. The difference in the dial indicator readings when the piston is supported and when it is unsupported gives the wrist-pin clearance.

3. Material Selection and Life

A considerable factor in the amount of downtime and the amount of maintenance required is the life of replacement parts. All work performed on an engine is to replace or correct for failures of material and equipment. A study of work being performed permits the location of weak points, giving a basis for correctional improvement.

Material failures result from poor or incorrect material, improper design, or mis-treatment of the material being used.

The first step in an analysis of material is the preparation of a complete downtime report, similar to that shown on page 1205. Assuming that this record reflects only downtime for the repair or replacement of faulty material, and not inefficiencies in the performance of the actual work, it can be used to locate the failures causing downtime. Without this report, only the obvious weaknesses will be noticed.

The second step is to analyze thoroughly for the cause, after it has been determined from the downtime report that a specific problem does exist. This second analysis seeks to establish whether the failure was caused by poor or incorrect material, improper design, or mis-treatment.

As an example of what can be done, here is the solution of a problem involving a power piston ring. Previous practice at this particular installation was to replace all power piston rings annually. Even so, many ring failures were being experienced between the scheduled replacements, causing considerable downtime.

After the problem was analyzed, it was decided a better lubricating oil and a change in ring design probably would be beneficial. The use of a better lubricating oil was started and one set of piston rings of an improved design installed for an experimental run. After observing the improvements resulting from these two changes following a year's operation, it was decided these changes were advisable for all units.

This installation now replaces power piston rings every two years and very seldom experiences ring failure. A problem of this nature is of major importance and will show considerable improvement in both downtime and maintenance expense. However, there are many minor problems in engine operation which can be analyzed and corrected to produce the same results. The study of material selection and life is a never-ending problem and material manufacturers are constantly endeavoring to improve material and parts design.

Acknowledgment

The preceding article is based essentially on the paper, "Maintaining Peak Efficiencies on Compressors—Power End," by Errol R. Wagner, Stanolind Oil & Gas Co., Odessa, Texas, and presented by Mr. Wagner at the 33rd annual meeting, Natural Gasoline Ass'n. of America, Dallas, Texas, April 21-23, 1954.

NEWS in VIEWS

DRY ICE FROM PETROLEUM—First shipment of the material is cut in blocks at Brea Chemicals, Inc., new plant at Brea, Calif. Company established the carbon dioxide unit as an adjunct to its recently completed aqua ammonia plant; makes 70 tons/day of the dry ice

Can Statistics Do Everything?

Probably only the most expert mathematician can answer the above question. However, this new technique has been finding wider and wider use in the management of plant operations. Earlier this year—in April, May, and June—PETROLEUM PROCESSING was pleased to present a series of three articles on "Statistics for Everyday Use," by a petroleum man who has found the technique extremely helpful in processing operations.

Now here is the other side. Here is the view of two process men who have found there are some very definite limitations to the usefulness of statistics, particularly as they worked with the technique on a sulfuric acid alkylation unit.

By ROBERT S. BRADLEY and IRVING W. SKAAR
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STATISTICS have been growing in stature recently as an important tool in the more efficient management of plant operations, just as they long have been so used in the laboratory.

Although sometimes capable of unbelievable accuracy in predicting what will happen, statistics will not always provide usable information and, in some cases, they will trip you flat on your face if depended upon excessively.

Statistics are no more dependable, at best, than the accuracy of the data available for statistical treatment. In the last analysis, statistics must be regarded merely as a more accurate way of approximating some best value of an average.

For instance, the optimum utilization of an alkylation unit in refinery practice depends upon a knowledge of the effects of operating variables. These can be subjected to statistical analysis to establish their influence upon both quality of product and yield.

The effects of operating variables on product quality have been presented by J. D. Wall,[2] wherein it was shown that, by statistical methods of prediction, the majority (54% approximately) of calculated octane ratings differed by not more than ± 0.2 from the actual value. None varied by more than ± 0.8 octane number. Either limit is well within the usual reproducibility of octane rating by the F-4 method.

Statistics failed in predicting light alkylate yield, however, using the same basic method of attack. The frequency distribution of error between observed and calculated yields calculated from the statistical solution developed indicated that two out of every three values should agree within ± 0.9% with plant data. It was found in reducing this to practice that probably only one out of every two predicted yields will agree within those limits.

Problem and Attack

The problem was statistically to predict light alkylate yields for the commercial unit described by Wall[2] to secure the best possible yields in routine plant operation.

A simplified flow diagram of the sulfuric acid alkylation unit in question is shown in Fig. 1. The four reactors are operated in pairs. Reactors 3 and 4 receive 60% of the olefin charge along with the recycle isobutane. Effluent from Reactors 3 and 4 overflows to Reactors 1 and 2, isobutane make-up being added to the overflow. Charging isobutane to the reactor pairs in series while charging olefins in parallel maintains a high external isobutane-to-olefin ratio in the reactors.

Fresh 98% sulfuric acid is added continuously to Reactors 3 and 4. Spent acid at 90% acidity is withdrawn from the settling drums. Each reactor has an emulsion circulation of about 100,000 b/d. A reactor temperature of 40-45° F. is maintained by auto refrigeration.

Crude alkylate is pumped from the acid settling drums to a conventional recovery system. The alkylate is debutanized to maintain a 6 lb. RVP. and rerun for a light alkylate product of 260° F., 90% ASTM distillation point. The heavy alkylate bottoms from rerunning, which contain polymerization products, are returned to cracking stock. For the present purpose light alkylate yield is expressed as percentage overhead from the rerun tower based on charge to the tower.

The operating variables affecting light alkylate yield are of the independent and interdependent nature, similar to those used in the quality correlation.[2]

The independent variables are ASTM initial boiling point of the heavy alkylate minus the 50% ASTM distillation point of the light alkylate, reactor temperature, and average reactor acidity.

The interdependent variables are olefin charge rate, emulsion circulation to olefin ratio, vol.-% butylene in the olefin charge, external isobutane to olefin volume ratio, external diluent to olefin volume ratio, total reactor hydrocarbon charge, and the vol.-% pentanes in the charge.

Concentrations of butylenes and pentanes in the charge are adjusted by the feed preparation system. The interdependent variables are functions of isobutane recycle and butane-butylenes charge rates and compositions. No fundamental data are available which would reveal the true relationship between the variables.

Routine plant data collected over a considerable period of time were used in developing the yield predictions.

Graphical studies were made to develop the overall trends, whence linear relationships appeared satisfactory for connecting the variables over the ranges studied. These ranges are shown in Table 1. They are by necessity limited because of the relative inflexibility of commercial operations and restrictions imposed by plant equipment.

A multiple correlation was then developed for determining coefficients of the empirical equation. The method described by Gore[1] was employed, with the method of Daigle and Young[2] used for solving the resulting simultaneous equations. The following expression was obtained as a result of these calculations:

$$Y = 0.0565\ X_A + 1.4642\ X_B + 0.1223\ X_C - 0.5747\ X_D + 0.2649\ X_E - 0.1132\ X_F + 0.0251\ X_G + 84.4$$

where Y = percentage light alkylate of total alkylate
X_A = IBP heavy alkylate minus 50% distillation point of light alkylate
X_B = external isobutane-to-olefin volume ratio
X_C = average acid strength (wt.-%)
X_D = total hydrocarbon charge to reactors, in 1000 b/d
X_E = external diluents to olefin volume ratio
X_F = butylene as percent of olefins
X_G = vol.-% total pentanes in the olefin charge

The nomograph shown in Fig. 2 was constructed to simplify use of the empirical equation.

The standard error of estimate for this correlation; i.e., the root mean square of the deviation of actual from calculated light alkylate yields, was found to be 0.9% for a yield range of 80 to 95%. The multiple correlation coefficient of the equation was 0.92, indicating that the data used, if plotted, would fall almost perfectly upon the line represented by the empirical equation.

The frequency distribution of the error between observed and calculated yields is shown in Fig. 3. This indicates that *two* out of *three* calculated values should agree within ± 0.9% with plant data.

However, 125 runs were examined for this study originally. Of these, only 74 were apparently usable since, upon examination, they were obviously "out-of-line." As it finally turned out, 16 of these 74 were discarded in following the customary practice of eliminating data which are apparently in error, representing 22% of the 74.

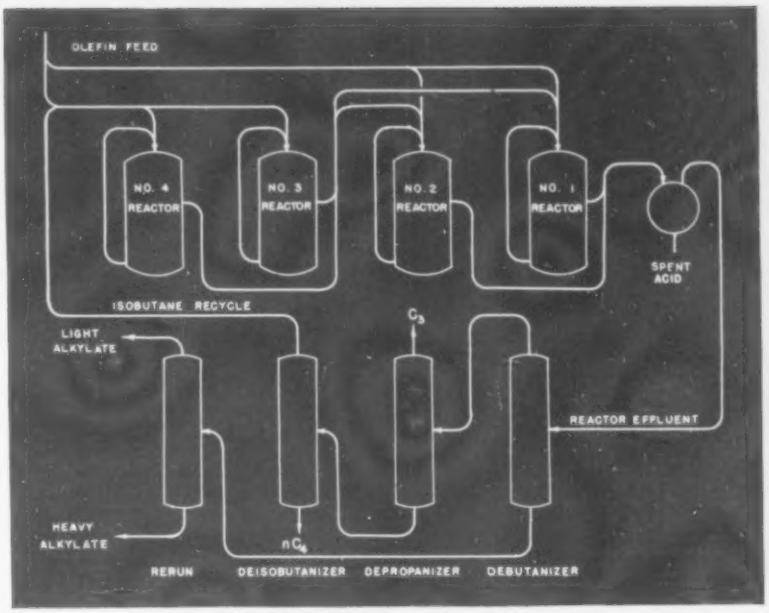

FIG. 1—Schematic flow in the sulfuric acid alkylation unit

A distorted picture thus is actually presented by Fig. 3 when these circumstances are considered; probably the same proportion of erroneous data or unreliable runs will be experienced in the future. Consequently, this gives logic to the assumption that only one out of every two—or perhaps only one out of every three—plant yields may agree with calculated yields within ± 0.9%.

Why Statistics Failed

The method of selecting variables for the above correlation was admittedly arbitrary. Secondary variables, such as external isobutane-to-olefin ratio, were plotted against yields. Only the variables having a definite relationship with yield were correlated. Lack of information on fundamental variables, such as isobutane-to-olefin ratio at the point of mixing with acid, prevented their inclusion in the empirical equation.

Table 1—Ranges of Variables Correlated

Light Alkylate Yield, %	80 - 95
IBP Heavy Alkylate—50% Point of Light Alkylate	120 - 165
Isobutane-to-Olefin Ratio	2.5 - 5.0
Acid Strength, Wt.-% H_2SO_4	90 - 93
Total Reactor Hydrocarbon Charge, 1,000 b/d	12 - 22
Diluents-to-Olefin Ratio	1.0 - 2.5
Butylene in Total Olefins, Vol.-%	75 - 98
Total Pentanes in Feed, Vol.-%	3 - 9

The effects of fundamental variables are concealed in the effects of secondary variables. Olefin charge rate was eliminated as a variable in preference to total hydrocarbon charge to the reactors. Likewise, the effects of temperature, degree of mixing and emulsion circulation—variables of recognized importance in the alkylation reaction—are included in the effects of other secondary variables or the equation constant.

Errors inherent in statistical quality control of some of the refinery operations are many[5]. If the fundamental variables of a process are already known, statistical methods are reduced to the determination of the average error. This can be done with an acceptable accuracy by the arithmetical as well as the least square methods.

Unfortunately, the statistical methods cannot be employed for developing the true relationships between the variables. In the above case, unknown variables affecting the yield might be present, though they could not be discovered.

Still other factors in plant operations must be considered. These factors arise from the human element, which cannot be eliminated by treating it as an abstract quantity or averaging it in a satisfactory manner. At the plant, errors may arise from inaccuracy of the instruments or plain neglect on the part of the operators. Statistics are as yet notoriously unreliable in the field of human relations and anything but infallible in predicting the performance of such inanimate mechan-

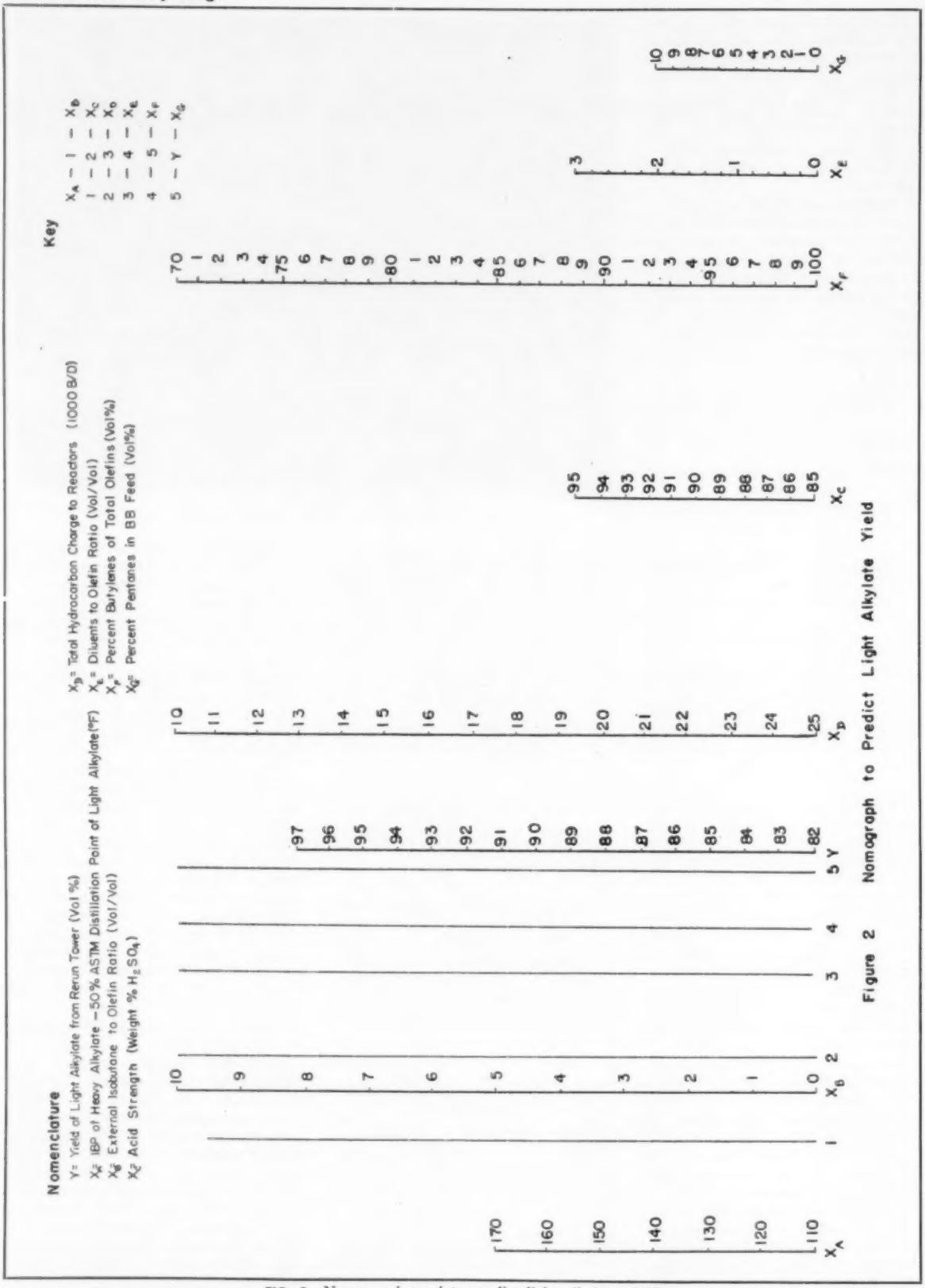
Nomenclature
Y= Yield of Light Alkylate from Rerun Tower (Vol %)
X_A= IBP of Heavy Alkylate – 50% ASTM Distillation Point of Light Alkylate(°F)
X_B= External Isobutane to Olefin Ratio (Vol/Vol)
X_C= Acid Strength (Weight % H2SO4)
X_D= Total Hydrocarbon Charge to Reactors (1000 B/D)
X_E= Diluents to Olefin Ratio (Vol/Vol)
X_F= Percent Butylenes of Total Olefins (Vol%)
X_G= Percent Pentanes in BB Feed (Vol%)
Key
X_A – 1 – X_B
1 – 2 – X_C
2 – 3 – X_D
3 – 4 – X_E
4 – 5 – X_F
5 – Y – X_G
Nomograph to Predict Light Alkylate Yield

Figure 2

FIG. 2—Nomograph used to predict light alkylate yield

isms as instruments and measuring devices. These errors can be caught if they are obvious. But, in many instances, they are not easily detected although they may have a deciding influence on the observed trends of the operating variables as estimated statistically.

Even the trends statistically determined on the basis of accurate data are unfortunately not entirely reliable if an optimum exists for a variable; that is, if the slope of the variable's effect is changing from positive to negative, or from negative to positive, within the range studied.

Depending on the limits chosen, such a variable might appear as a constant or show an upward or downward trend without ever revealing that the optimum exists. Therefore, statistically developed equations cannot be safely extrapolated. Likewise, they cannot be applied over wide ranges of interpolations as they are liable to obscure the effect of some variables.

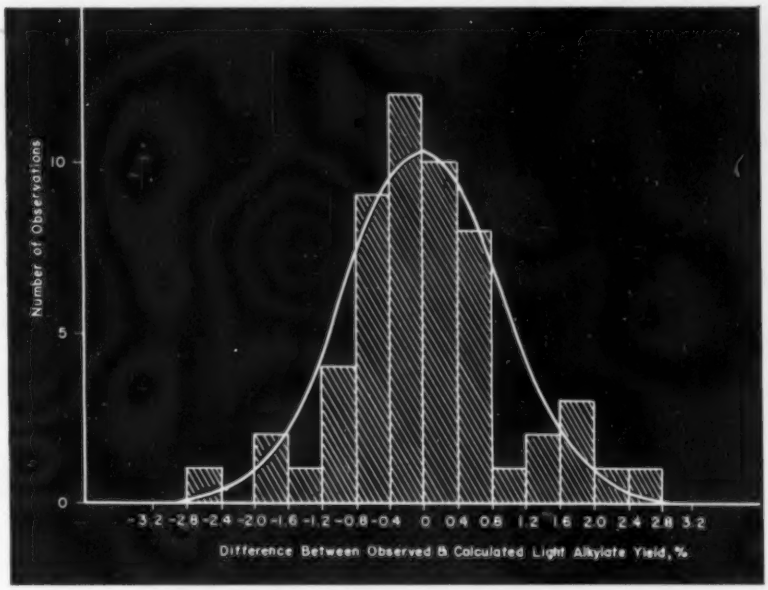
Number of Observations
10
5
0
-3.2 -2.8 -2.4 -2.0 -1.6 -1.2 -0.8 -0.4 0 0.4 0.8 1.2 1.6 2.0 2.4 2.8 3.2
Difference Between Observed & Calculated Light Alkylate Yield, %

FIG. 3—Frequency distribution—observed vs. calculated yields

Practical Results

Statistical attack has had two practical results in this case:

First, the empirical equation so developed has proven useful in the plant as a rough guide in operations to indicate the approximate yields which should be obtained under various operating conditions.

Second, the correlation has strengthened the belief that light alkylate yield is influenced by the following reaction variables:

1—High reactor charge rates decrease the production of light alkylate by lowering the effectiveness of the catalyst; i.e., the acid to hydrocarbon ratio. However, economics usually justify maximum charge rates.

2—External isobutane-to-olefin ratio directs the type of reaction. High ratios lessen the tendency towards side reactions of polymerization.

3—Volumetric conversion depends upon the type of olefin present[4]. Conversion decreases as the molecular weight of the olefin increases. This is indicated by the decrease in yields at high butylene concentrations.

4—High reactor acidities favor light alkylate production. However, acidity level also is dependent upon local economics, as acid is a major process expense.

Limitations applicable to the statistical quantity (yield) control methods also exist in statistical quality control although they might not be so obvious. This is explained by the possibility of obtaining spot samples for determining product quality under conditions of steady plant operation; this tends to reduce the influence of the human element.

The present investigation has been done with the full knowledge of the factors involved, but with the understanding that something—if it happens to work—is better than nothing. The reliable analysis of the problem discussed in this article must await the time when sufficient data are available to permit their interpretation by a strictly scientific approach to the subject.

Acknowledgment

The authors are indebted to Magnolia Petroleum Co. for permission to publish this article, and to V. A. Kalichevsky for his helpful criticisms and suggestions.

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(5) McGovern, L. J. "Statistical Quality Control — Applications and Limitations." *Petroleum Refiner*. Vol. 32, No. 2,pp, 121-124. February, 1953.

Meet the Authors

Mr. Bradley

Mr. Skaar

Robert S. Bradley, a process engineer with Magnolia Petroleum Co., Beaumont, Texas, in the technical department of the refining division, has done work on alkylation and catalytic feed preparation and presently is engaged in economic evaluation studies.

A 1951 graduate from Texas A&M College with a B.S. in chemical engineering, Mr. Bradley spent two years in the Army before joining Magnolia. Still single, he claims his chief outside interests center on golf.

Irving W. Skaar, a junior process engineer in the same department as Bradley at the time this article was prepared, now is in the technological department at Shell's Norco, La., refinery. Mr. Skaar has a chemical engineering degree from Brooklyn Polytechnic Institute (1952), and has done work for Magnolia in lube oil manufacture and in alkylation. Married, he makes swimming instruction at the YMCA his outside interest.

Are you—as a petroleum processing plant operator—getting all you have coming out of your construction dollar?

No, says this author, and it's probably your own fault.

Then, he presents eight $-saving points that will help you work with your contractors, and backs them up with personal experience gained as a project engineer on plant construction with a large contracting firm.

And, if you're a contractor maybe you'd better read his last two paragraphs first.

8 DOLLAR-SAVING TIPS TO

Keep Construction Costs Down

By JOE R. FULLER, Port Arthur, Texas

HOW many times have you heard this old "song-and-dance" during a plant construction project?

Plant operator: "Hey, we can't have that valve up there. It's gotta be down here where we can see this gage."

Constructor: "Well, that's where it showns on the print. That's what I go by."

Operator: "I don't care. It's gotta be changed."

Constructor: "Okay, then, I'll make out an extra work order and let you sign . . ."

Operator: "Oh, No! I'm not going to sign a XZ@!b&— thing!"

I think I could retire if I had a dollar for every time I've heard that or something like it.

And so it goes. Perhaps it's our fault as constructors. But, the operator could have saved somebody some money if he'd looked at the drawings before the pipe was erected. And he would have saved a lot of money if he had caught it before the pipe was fabricated. Situations like this crop up almost daily in the construction of new refinery and petrochemical plant units — and money frequently is wasted.

Can you, as an oil company executive, do something about it? Quite possibly you can. There are certain rules you can follow which will mean dollars saved when the cost sheets for either new construction or revamp work are examined. These dollar-saving points include:

- Don't start the job too soon.
- Don't circumvent the contractor's chain of command. Follow channels.
- Keep everyone in your organization informed, and have them make the changes before (not after) erection.
- Be sure that the exact nature of the job is described as completely as possible in the contract and the "specs".
- Don't overdo—or underdo—safety and cleanup campaigns.
- Never forget the dynamic quality of a construction job. Delays and indecision always cost money.
- See that field changes are engineered to completion.
- Don't order work to be done "right away" if you can avoid it.

Admittedly, these sound like copy-book maxims. Yet in our jobs we have seen every one of them violated time after time. A sympathetic and alert oil company management will follow these rules, and will stop the waste of many of the construction dollars, which can be so easily lost on a project.

An oil company's procedure with its contractors ought to be about the same for all types of contracts—whether on a fixed-fee or a cost-plus basis. Bids on fixed-fee work are based on costs for previous fixed-fee work. If foundation costs on one job in a certain refinery are high, regardless of cause, this certainly will be reflected in the next bid.

There are differences, of course—you would not give away a quantity of material to keep the job going on fixed-fee work, whereas you would on cost-plus. But as to the degree of enforcement of specifications and regulations, and a sympathetic understanding of the contractor's position, it will be money in your pocket in the long run to treat all contractors the same, turnkey or otherwise.

Don't Rush into the Job

One big mistake often made in refinery construction is starting the job too soon. Regardless of which type of contract is involved, it seems that frequently ground is broken before it should have been. As long as only a superintendent and a material man are on the job there is very little overhead to consider. But, once ground is broken, overhead costs will begin in earnest, and continue relentlessly until the day the job is over.

Major foundations can be installed in from two to five months on almost any size job. After foundations are installed, if there is a month's delay before fabricated pipe (or structural steel supporting it) arrives at the job site, there invariably will be a large, unnecessary overhead cost. True, many of the journeymen will be laid off when work slows down, but the office, material, and engineering sections, and usually the craft foremen, will be retained once the organization is built up.

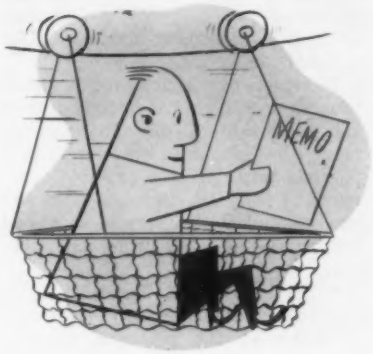
The time to take that one month delay is not during the middle of the job, but before the job starts. The executive who delays decisions as to size, location, or process until the rapid tax write-off deadline catches him will find that higher costs are the result.

Piping is by far the biggest item in the labor costs for erecting a refinery unit. One variable to watch when scheduling the time to begin pipe erection is how long the customer (oil company) will delay drawings which he is required to approve. If piping drawings are delayed three weeks (which is not uncommon) then pipe fabrication, and consequently job progress, is delayed three weeks.

With a weekly payroll of $20,000 per refinery unit being constructed, Mr. Refinery Executive has just spent a pile of money.

Conversely, of course, starting the job too late will delay job completion, or require overtime work to complete on schedule, particularly if you are held up by work stoppages. The decision as to when to break ground is an important one, and should be based on the estimated time of arrival of material and approved drawings. Past experience as to the reliability of delivery dates furnished by individual suppliers should be considered.

Suffice it to say that more jobs are started with the idea of "when we would like to have the unit" than with the idea of "when our material schedule will allow us to have the unit," and higher costs are the invariable result.



Use Regular "Channels"

A few customers' construction representatives have a bad habit on cost-plus work: going down into our organization and giving orders to our foremen, pushers, or journeymen, without informing our people of the changes made. Both union regulations and the tenets of good leadership require that no one except the foreman give orders to his men.

If a foreman tells a man to do one thing and someone else tells him to do another, then the productivity of the man himself falls off markedly and the foreman will "lose face" and become dissatisfied with the way the job is going.

The way to get efficiency out of an area superintendent is to work all things under his command through him. If this is not done, then you are paying this man's salary for nothing. The major refinery contractors do not do "force account" work. They are supposed to send competent personnel to the site, and you as the customer are paying for this personnel. Always use them, and the job will go much better.

Keep Information Flowing

One of the biggest contributors to high costs, either in increased original expenditures or in extra work, is indecision and poor internal communication on the part of the oil company.

Probably two-thirds of all first drawings are changed significantly before the finished installation is finally put on stream. And perhaps 10 to 20% of these changes are not made early enough to prevent extra expenditures for labor and/or material, usually after equipment has been installed or after pipe is fabricated.

Several months ago we pulled the same piece of 8-inch pipe in and out of an operating unit *three times*, making different revisions, most of which could have been incorporated in the original drawing with sufficient forethought.

Other examples are numerous:

On one unit we installed, seven small pumps were located under the tower structure. Because it was planned to carry the pump foundations on the thin floor slab, we poured the big spread footing for the tower structure foundation, then backfilled and tamped four feet of fill dirt over it.

After that was completed, the customer decided it would be better to carry the pump foundations on the tower structure foundation. The area was then re-excavated, with shoring being necessary this time to keep the new fill dirt from caving in.

After the excavation was completed, forms fabricated and partially installed, and steel bent, a telegram was received in the field to hold this work pending redesign of the pump foundations. There was a question in our minds as to whether we should lay off the carpenters, reinforcing rodmen, and laborers involved, since the revised

drawings were expected daily. These revised drawings were finally received a month later, with only minor changes.

Labor costs for these foundations were about double what they should have been. And this extra dribbling away of our customer's money could have been prevented by: 1) not starting the job so soon, and 2) initial thorough investigation and decisive action by the customer.

In some plants, the first knowledge that operating personnel have of construction work is when they see it being built. Sometimes they don't even see the prints, and other times they get the drawings but don't go into them in detail before work commences. (And strange to relate, some graduate engineer operating personnel bog down on isometric drawings that our pipefitter foremen can read with the greatest of ease.) An early, thorough study by all concerned will often prevent the situation dramatized above, where the operator says he's "gotta have that valve moved down here where I can see this gage."

Read the "Fine Print"

With the entry of a number of new firms into the refinery construction industry during the past few years, competition for jobs is much more severe. Many of the "frills" in refinery units are things of the past in fixed-fee work. On firm price jobs it will be of great benefit to the established contractor with a reputation to preserve (and to the oil company), if work to be done is defined as completely as possible, with few loop-holes which could involve extra work.

You will certainly save money if you cover all work in the first bid, rather than asking the contractor how much he will charge to make a given addition as an extra.

Be Consistent on Safety

Intelligent administration of safety regulations can save refineries and contractors a lot of money in insurance costs, not to mention the feeling for the individual concerned.

However, overly stringent or unreasonable rules enforced in the name of safety can slow the job down and run labor costs up. One job we did in a petrochemical plant required the removal of several small foundations and the installation of a very large spread footing in the edge of an operating unit.

We were told that fire hazard precautions required that we play a stream of water on the point of concrete breakers (doubling labor costs for removing concrete!) and that dump trucks would not be allowed near the excavation. About 400 yards of earth were removed by hand and wheeled out of the unit in wheelbarrows.

Yet we were allowed to back concrete trucks up to the excavation, and company trucks with water mufflers daily drove further into the unit than our trucks would have gone. Later, with proper precautions, we were even to have been allowed to burn and weld for weeks in the same location. Finally, near the end of the project we were allowed to bring dump trucks to the site.

This inconsistency in safety regulations ran total labor costs for this foundation up to about $20,000. If permission had been granted to chip concrete without a water stream, back a dump truck up to the hole, burn off steel bars and other obstructions, etc.; the foundation would have been installed for less than $18,000.

Incidentally, this same foundation could be installed on a virgin site, using machine excavation, and without chipping-out, shoring, cross-bracing and the like, for not more than $5,000 in labor costs.

It's the same story with clean-up work as the job progresses—too little is bad, too much is bad. A contractor should keep his own house pretty much in order, for morale and safety purposes, and to give people and equipment clear working areas. But if workmen have to walk to the carpenter shop or the scrap heap every time they need "a couple of boards to set this exchanger on," then time is lost.

Recently, before a unit shut down for its turnaround, we carried some large prefabricated pipe over from the designated storage area and set it next to the unit. Some of the pipe was not installed at that time, but was to be installed several months later.

During a clean-up campaign prior to the arrival of a high company executive, we were requested to return the pipe to the storage yard, which we did. This pipe was handled *four* times with a winch truck and a "swamper", before it ever got inside the battery limits.

Any good construction man knows that material should be unloaded so that it need be handled only one more time, i.e., when it is installed. Yet on one job several years ago we had to move our entire fabricated pipe storage yard from its approved location. Hundreds of pieces of pipe, laid out according to line number, were moved to make way for another contractor to install a new unit which had been planned for months. A little foresight would have prevented this cost.

Keep Moving: Delays Cost $

It is hard to convince those who are not intimate with construction of the *dynamic* quality of the job, and the need for speed.

A pipefitter gang's wages are $250/day. If a $75 premium for air freight instead of motor freight will allow

them to work at full efficiency tomorrow and the next day instead of half efficiency, then by all means send the material by air freight, and be quick about it.

Many times we have seen the job held up while the possible substitution of materials or the use of a high-priced versus a low-priced material is being determined. Often the amount of labor time lost will be more than the value of the material in question. If the decision is made, then later reversed, even more time is lost, and the workmen concerned will subsequently work at lower efficiency because of indecisive leadership.

The requirement is a difficult one: you have to make your decision fast, and it's got to be right.

The construction superintendent makes a $1000 decision every time it rains.

If he sends the men home and the weather clears up 30 minutes later, disgruntled workmen may slow the job down for several days after that. If he keeps them on the site and it rains all afternoon, he loses a $1000 worth of labor time. When oil company personnel make decisions regarding a construction job after the job has begun, this dynamic quality of the job must be remembered.

Check Changes Completely

One thing should be mentioned concerning small changes or additions by the customer, especially those given us by field personnel: they are rarely engineered to completion.

Processwise, they will be quite correct—but as to structural layout, foundation, check for interference, details of construction, bills of material, and the like, they are not the finished product we get in our own drawings. It will cost a little more in drafting time to turn out and check a completed detail drawing, but that cost will be more than recovered during construction.

But, No "Rush Job" Either

Any task that has to be done "right away" is going to cost more money than it would if it could be worked into the schedule. If a gang is pulled off one job and put on another, you may as well figure a minimum of one hour's lost time for that gang. By the time tools are turned in and other tools checked out, new material brought to the site, and all concerned understand what is to be done, at least an hour will be wasted.

The refiner should remember that from the contractor's viewpoint the problem of lowering labor costs is often made more difficult by the necessity of maintaining good customer relations.

On cost-plus work, if our customer wants "eight boilermakers over in the West Area right away," or wants "this scaffolding taken down right away," we've got a problem. We'll usually tell him that it costs more to work that way, but we'll generally end up doing just as he says.

We are faced with a dilemma: either we argue with him now, and he begins to get the idea that our company doesn't give very good service, or else we don't object to what we feel are questionable practices, and we have to answer for high costs at the end of the project.

This doesn't mean to say that the person concerned cannot make wise decisions concerning the use of personnel. It is meant to say, though, that whenever possible he should plan all this sort of work in advance. And if emergency work must be done, realize that you are paying a premium for it.

Not long ago, I asked the top construction man in the home office of one of our clients if he thought he got the maximum return out of his construction dollar.

The answer was a decided "No".

And how do they err most often? He sums if up better than I did: in *scheduling:*

"Our home office sets up a schedule of a sort for construction work, but many of the people who work on the schedule don't know much about construction," he said, "particularly about the time required for doing certain tasks.

"Then comes the worst part—the engineering and purchasing departments don't meet the schedule, and there is the field with a big crew on their hands with nothing for them to do.

"If they go ahead and do the work, some of it will have to be done over. The people in our home office don't realize how much they cost us by improper scheduling and not attempting to follow schedules."

Then he ended up with this word of advice: "You know, I think you contractors could stand a little improvement in that respect yourselves."

He's right. Many of the items in this article apply to contractor's management as well as to that of oil companies.

If the future will bring a better understanding and more consideration for the problems encountered in the field by all concerned, there is no doubt that field labor costs can be substantially reduced.

Meet the Author

Joe R. Fuller received a B.S. in civil engineering from Texas A&M College in 1951, after two interruptions: one for service as a lieutenant in the infantry division, U. S. Army, and the other for service as a field engineer for a builder of a refinery in Venezuela.

Since graduation, he has served as engineer and as a chief engineer under the construction manager of one of the major contracting firms in the erection of several refinery and chemical plant units on the Gulf Coast. A native of Port Arthur, Texas, he is currently attending Harvard Business School, where he expects to receive a master's degree in business administration in June, 1955.

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Mr. C. A. Barrere
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Dear Mr. Barrere:

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After 20 days of continuous operation the unit has demonstrated completely satisfactory operability under the provisions of our contract, and this letter will serve official notice to you that as of this date we are taking over operation of this unit -- subject, of course, to the usual continuing guarantees of materials and equipment.

Please extend our sincere compliments to all of the members of your organization who worked on this project for a job exceptionally well done.

Yours very truly,

R. T. Colquette

R. T. Colquette.

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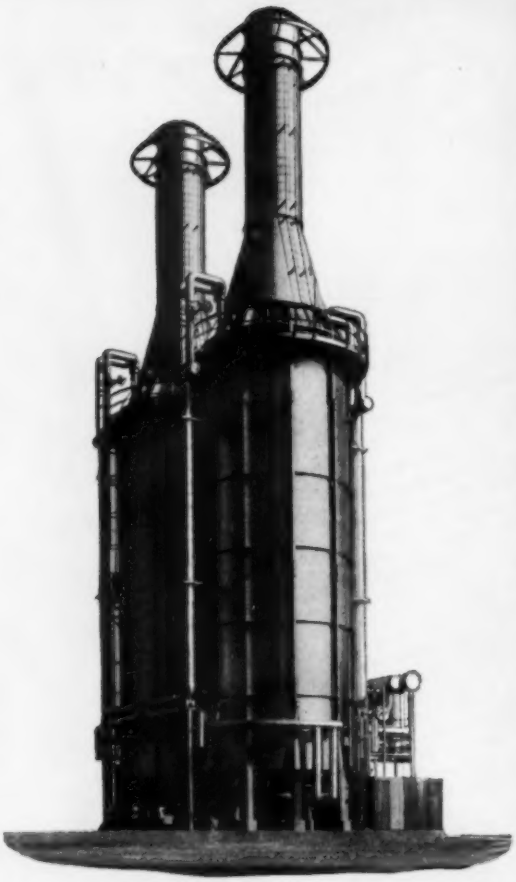

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IN THIS SECTION

Newest Phenol Plant

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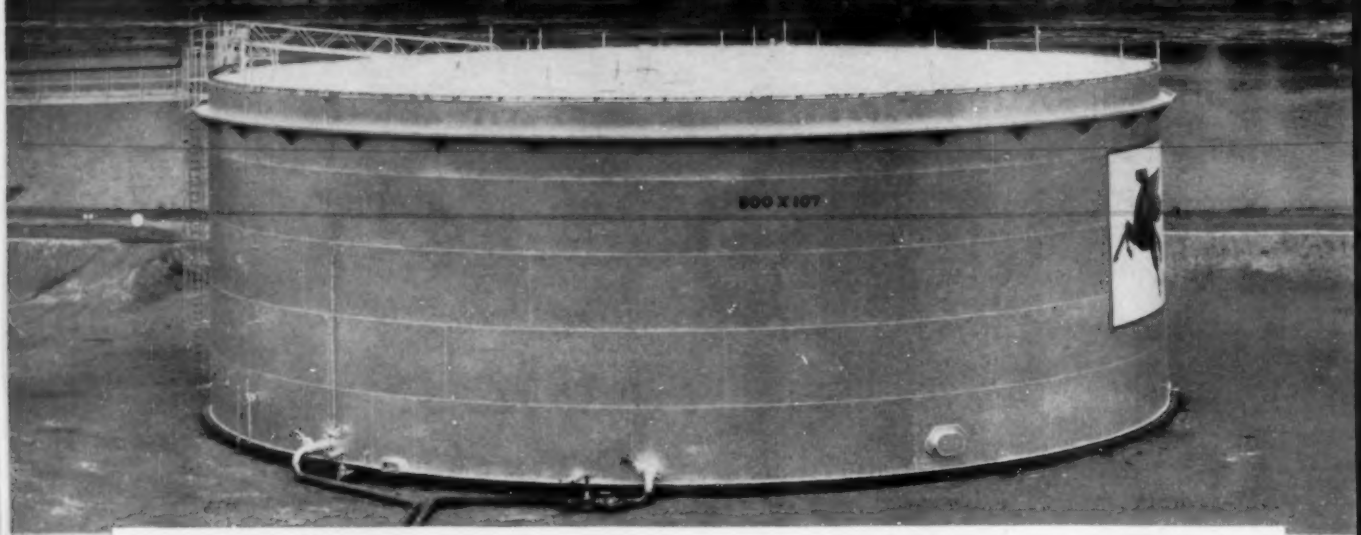
FIRST CHOICE

HORTON DOUBLE-DECK FLOATING ROOF



Horton® Double-Deck Floating Roofs, like the one in this 80,000-bbl. welded steel tank built for General Petroleum Corporation at Portland, Oregon, are the first choice of the petroleum industry to provide dependable, efficient, economical storage for volatile petroleum products. Throughout the industry today, storage tanks with Horton Floating Roofs are reducing evaporation loss, corrosion and fire hazard. They are particularly recommended for tanks that are filled and emptied frequently.

How the Double-Deck Floating Roof Works

Floating directly on the surface, the entire bottom of a Horton Double-Deck Floating Roof is normally in contact with the liquid in the tank. There is no space above the liquid for air-vapor mixture to form. All loss caused by filling and emptying is eliminated. Fire hazard is reduced and corrosion of the tank and roof is minimized.

Horton Seal

Standard construction on all Horton Floating Roofs is the very effective Horton Seal. This device closes the space between the deck of the roof and the shell of the tank. Vertical flexures every 22 inches allow the sealing ring to flex enough to conform to the inside of the tank shell. Pantagraph hangers support the sealing ring and keep the roof centered at all times. A gastight, flexible fabric closes the space between the top of the sealing ring and the deck of the floating roof to complete the seal.

Information or quotations on Horton Double-Deck Floating Roofs may be had by writing our nearest office.

CHICAGO BRIDGE & IRON COMPANY

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SALES OF FERTILIZER AT SERVICE STATIONS were launched by Phillips Petroleum Co. with the presentation of the first 25-lb. bag of ammonium sulfate by T. L. Cubbage, vice president and general manager of Phillips Chemical, to A. M. Hughes, vice president of Phillips Petroleum Co.'s sales department.

NEW STEP IN THE PETROCHEMICAL FIELD—

Selling Fertilizer at Gas Stations

A Staff Report by the Editors of PETROLEUM PROCESSING

IN selling solid type ammonia fertilizers at its own and dealer service stations Phillips Petroleum Co. is exploring a new possibility in merchandising a petrochemically-derived product direct from the oil company manufacturer to the consumer.

During the spring, ammonium sulfate and limited quantities of ammonium nitrate were made available to petroleum jobbers and consignees for direct sale to farmers. In addition, starting in March, the company made available ammonium sulfate in 25, 50 and 100-lb. bags for sale through service stations for lawn and garden use. The products are made and packaged at the Etter, Texas, plant of the subsidiary Phillips Chemical Co. and the Adams plant on the Houston Ship Channel.

Both moves are in line with the general marketing philosophy of the oil companies of selling petroleum products direct to consumers through their gasoline stations or by truck delivery. For years the companies have merchandised at their stations petrochemicals of the insecticide spray variety, along with their petroleum specialty products. The venture of Phillips is with a petrochemical product not associated in the public's mind with gasoline, motor oil and other petroleum products. The company is of the opinion, however, that the new line will help their jobbers and dealers sell more of the conventional products at service stations. When the fertilizer merchandising program started the company announced:

"For years farmers have used ammonia fertilizers for higher crop yields and more income per acre. In recent years homeowners too have been using this high nitrogen fertilizer. They have discovered it produces greener, healthier and more vigorous lawns. Consumers have rushed to retail outlets to purchase this outstanding nitrogen fertilizer.

"Now, Phillips is making ammonium sulfate available through Phillips service stations. It's to your station that all the homeowners consistently return. It's to your station that more new customers will come when they learn you are handling Phillips 66 fertilizer. And that's the point. By stocking this top-notch fertilizer you receive double benefits.

"First, you make nice profits from fertilizer sales. Second, you stand to gain many new gasoline customers."

Plant output is being increased by Phillips for both types of solid nitrogenous fertilizers, am-

APPLYING ANHYDROUS AMMONIA as crop fertilizer at the rate of 50-75 lbs. per acre. Ammonia is metered from a 110-gal. supply tank mounted on the tractor, deposited 4 to 6 ins. in the root zone of the crop and immediately covered.

Estimated Cost and Profit Figures for Direct Sales of Ammonium Sulfate and Ammonium Nitrate

	Ammonium Sulfate $ ton	Ammonium Nitrate $ ton
Wholesale Price Delivered in Chicago	63.00	83.00
Wholesale Markup	3.00	4.00
Price Delivered to Dealer	66.00	87.00
Typical Dealer Markup	8.00	10.00
Dealer's Price to Consumers	74.00	97.00
Total Markup on Direct Sale	11.00	14.00
Marketing Costs (Includes unloading and handling $2/ton, storage $1/ton, financing $1.50/ton)	4.50	4.50
Combined Gross Profit	6.50	9.50

monium sulfate and ammonium nitrate. A large percentage of the total output, however, will be anhydrous ammonia, which has the advantage as a fertilizer of a higher nitrogen content, 82%, as compared with 21% for ammonium sulfate and 33% for ammonium nitrate.

Costs go up for the solid type, particularly for bagging and transportation. However, the dry fertilizers have the advantage of being easily marketed from stores, service stations and easily handled at oil jobbers' bulk plants. The seller has nothing to do with their application in the field. The capital investment required to stock them is much lower than for anhydrous ammonia, which requires pressure storage tanks and special equipment for distribution and application, the last in most cases being done by the seller of the material.

The wholesale oil marketer considering stocking the dry fertilizers to distribute to service stations or other outlets should plan on a minimum inventory of 20 tons to make the venture profitable, the Phillips company states. Ammonium sulfate, supplied in bulk and in 25, 50 and 100-lb. bags, could be stored in a dry, clean part of the marketer's warehouse along with packaged petroleum products. The ammonium nitrate fertilizer, distribution of which Phillips is now starting, will be sold only in 100-lb. bags.

Ammonium nitrate must be stored in a separate warehouse and kept removed from petroleum products. An accompanying table gives typical cost and profit figures from direct sales of ammonium sulfate and ammonium nitrate.

Anhydrous ammonia is supplied by Phillips as fertilizer to about 200 operators who have bulk storage facilities for handling it. Some are wholesale marketers of petroleum products, but company officials are not all of the same opinion as to whether oil jobbers should enter the anhydrous ammonia business. One point in their favor, however, is that in their distribution of petroleum products they know the farmers in their territory and the kind of farming they carry on.

Since the distributor of anhydrous ammonia generally makes the application in the farmer's fields, it is necessary that he have a thorough knowledge of farm practices, agronomy, and the chemical construction of soils.

Anhydrous ammonia cannot be sold without the proper receiving, storing, handling and applying facilities. The system required will vary with the type of farming practiced and other factors but the minimum capital investment necessary would be around $30,000. The most popular storage, according to Phillips officials, is a 30,000-gal., 250 psi. tank holding 65 tons of anhydrous ammonia in liquid form and similar to the pressure storage tanks used for LPG.

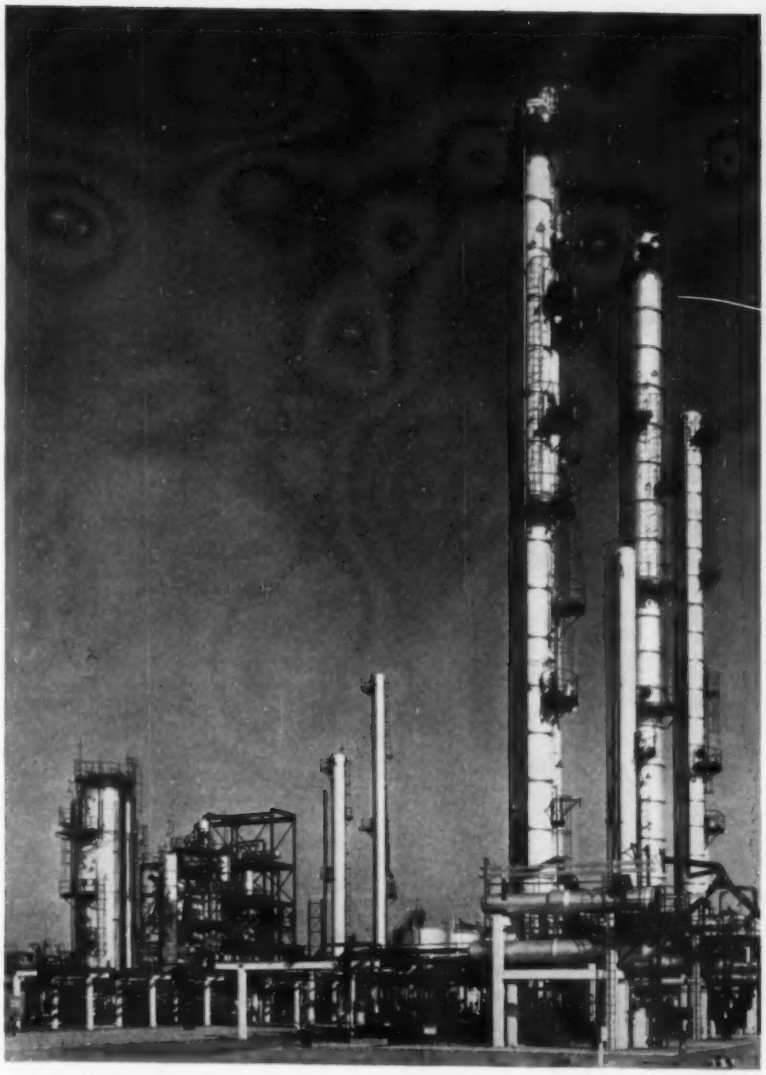
Phillips Petroleum Co., through its subsidiary Phillips Chemical, is one of four U. S. oil companies which are pushing up their production of ammonia from natural gas as base material for fertilizer. Phillips entered this field in 1948 when it leased the Cactus Ordnance plant at Etter, Texas, which during the war was a big source of ammonia for explosives. Since acquiring the plant Phillips has increased the capacity for anhydrous ammonia to 440 tons daily. This represents an average yield of one ton of ammonia from 100,000 cu. ft. of natural gas and a daily aggregate of about 18 tank cars of ammonia as the primary product. Early in 1954 Phillips completed a new ammonia plant at its Adams terminal on the Houston Ship Channel, with a daily capacity of 465 tons.

Shell Chemical Corp., subsidiary of Shell Oil Co., and one of the four principal oil company manufacturers of ammonia, produces around 450 tons daily from two West Coast plants.

Lion Oil Co.'s daily production is 580 tons per day, 160,000 tons per year of ammonia at its El Dorado, Ark., chemical plant and 350 tons at a plant near New Orleans.

Brea Chemicals, Inc., subsidiary of Union Oil Co. of California, is expanding its production of ammonia at Brea. Standard Oil Co. of Ohio is considering building ammonia plants to supply fertilizer in its petroleum product marketing territory.

The expansion of Phillips, Shell, Lion and Union Oil in ammonia production recognizes the growing demand for nitrogenous type fertilizers, and by 1955 it is expected that U. S. nitrogen production will approximate 3,000,000 short tons, of which more than 2,000,000 tons will be derived from natural gas. This will rank ammonia from natural gas, as a source for nitrogen, among the top petrochemicals from a tonnage standpoint.



MORE SYNTHETIC PHENOL, 35 million lbs. a year will come from California Standard's new plant at Richmond

NEWEST PHENOL PLANT

It's 100% from Petroleum

THE second new synthetic phenol plant to go onstream on the Pacific Coast—Standard Oil Co. of California's 35,000,000-lb./year cumene route plant at Richmond—is also the first anywhere to produce phenol from 100% petroleum sources.

It is also the first in the United States and second in the world to use this Hercules Powder Co. process: the Montreal, Que., plant of B. A.-Shawinigan, Ltd., was the world's first unit to use the process. However, whereas the Canadian plant uses coal-tar benzene, Standard's plant uses benzene from petroleum stocks.

The process used at Richmond, licensed by Hercules, operates on a cumene feedstock manufactured at California Standard's El Segundo refinery from Platformer-produced benzene and from propylene. It actually starts with the liquid-phase reaction of the propylene and benzene using phosphoric acid catalyst to produce cumene.

This step in the process, carried out at El Segundo, was designed and is licensed by California Research Corp., a California Standard subsidiary. The second step in the process involves the air oxidation of cumene to cumene hydroperoxide. This in turn goes through acid cleavage to yield phenol and acetone.

Overall phenol yield is about 80% and a typical ratio of reaction products is phenol 57 parts; acetone, 34 parts; alpha-methyl styrene, 6 parts; and acetophenone, 3 parts. Initial output of phenol is said to have been U.S.P. grade in purity.

As a by-product the new plant will produce some 20,000,000 lb. of acetone annually in addition to the 35,000,000 lb. of phenol. Both products will be marketed by Oronite Chemical Co., another California Standard subsidiary.

End uses for the phenol are estimated by the company to be: 60% for phenolic resins for laminated wood, wood waste boards, and for rock wool and glass wool insulation binders; 25% for other chemicals, such as 2,4-D and salicylic acid; 10% for miscellaneous solvent extraction processes; and the remainder for export. California Standard is itself a big consumer of phenol.

Output of the new plant, along with 22,000,000 lb./year (estimated) from the nearby Avon, Calif., plant of Monsanto Chemical Co., represents the total West Coast production of synthetic phenol. Monsanto's plant uses the classic sulfonation route.

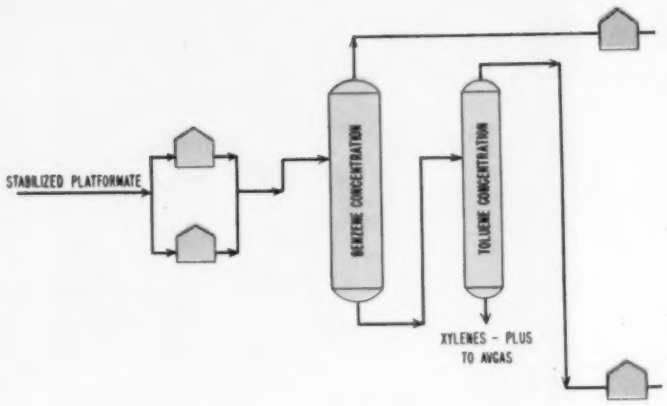
There are two other phenol-from-cumene plants at present under construction in the United States. One is a 30,000,000 lb./yr. plant at Frankford, Penna., for Allied Chemical & Dye Corp.'s Barrett Division; and the other is a 15,000,000 lb./year plant at Paulsboro, N. J., for Hercules Powder. Total expected production from all synthetic phenol plants, regardless of process, built and being built, will reach about 578,000,000 lb./yr.

The cumene route to phenol competes with other more-established processes using sulfuric acid and chlorine. Its industrial advent was blessed with good timing. It coincided with the peak shortages of these latter two chemicals in the post-World War II years.

Economics are regarded favorable to the cumene route by many authorities. Net production costs are affected substantially by the growing market for acetone. Furthermore, ready availability of benzene from petroleum in growing quantities—through catalytic reforming—casts a favorable light on the cost picture.

Aromatics—Nitration Grade

Shell's new unit recovers benzene and toluene from catalytic reformate by phenol extraction



HIGH PURITY AROMATICS are produced by Shell in the recovery unit shown in this schematic flow chart

THE largest extractive distillation facility of its kind in the U. S. for recovery of nitration-grade benzene and toluene from catalytic reformate has successfully passed performance tests and settled into routine operation at Shell Oil Co.'s Houston, Texas refinery. In connection with it is a 16,000-b/sd Platforming unit.

Aside from size, the extractive distillation and Platforming units have other distinguishing features. Among them is the largest installation to date of Shell's recently-developed "Turbogrid" trays. Also, centrifugal compressors instead of the usual reciprocating type handle recycle hydrogen while nitrogen is used as a purging medium in the reactor section of the Platformer.

All distillation towers but one in the aromatics recovery section are reboiled with a heavy sweet gas oil as heating medium. Steam is used for reboil heat in the benzene rerun column. Extensive precautions have been taken to minimize the possibility of process upsets caused by utility failures.

The Shell extractive distillation process for the recovery of aromatics is based upon inducing a relative difference between the vapor pressures of non-aromatics and aromatics having approximately the same boiling points, by the introduction of a certain dissimilar material. In the case of petroleum hydrocarbons mixed with benzene and toluene, the dissimilar component usually is phenol:

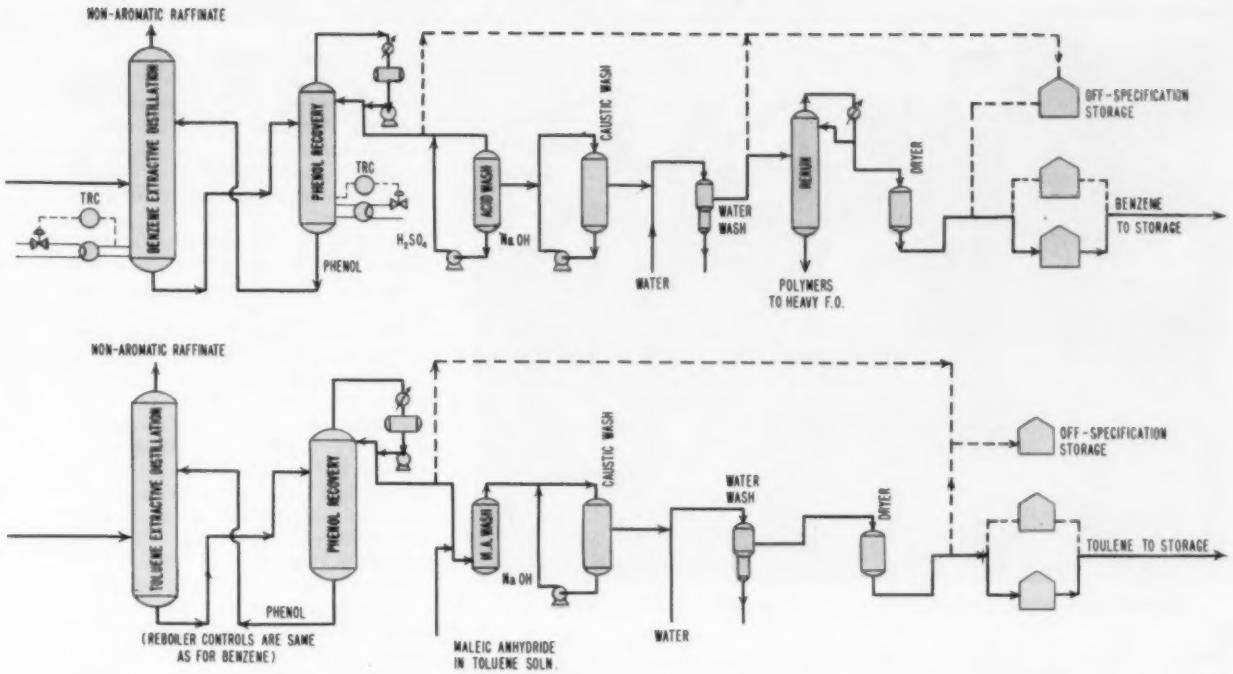
HIGH PURITY BENZENE AND TOLUENE are produced in this extractive distillation unit

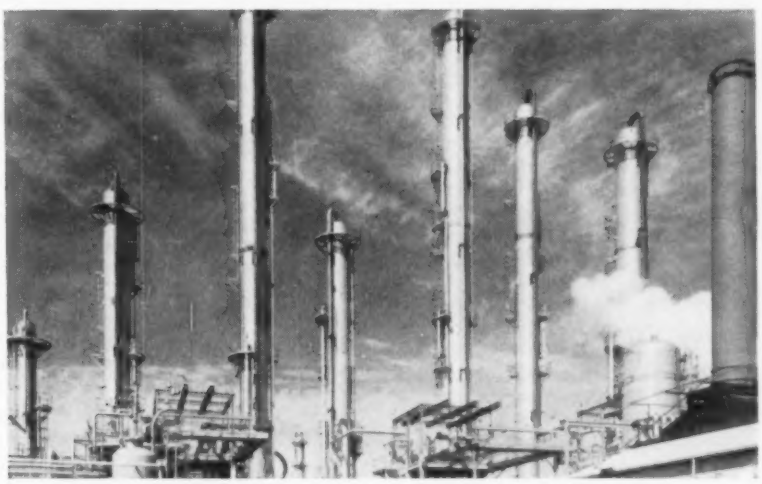
where xylenes also are to be recovered, the preferred additive component is a mixture of cresols.

In practice, the aromatics mixture is split into benzene- and toluene-concentrate cuts; a third cut of xylene-concentrate would be desirable where these homologs are also to be recovered. The appropriate fraction then is extracted with phenol (or cresol), the non-aromatics going overhead as raffinate. The desired aromatic is then stripped from the solvent and the recovered aromatic treated as necessary to meet specifications.

A schematic flow diagram of the aromatics recovery unit is shown above. Stabilized Platformate, containing in addition to the aromatics some unreacted precursors and paraffins, is supplied to one of two 10,000-bbl. tanks where, by means of mixers, a reasonably uniform feed is maintained. Typical feed is shown in Table 1.

In two conventional fractionating columns (except that they are equipped with "Turbogrid" trays) the feed is split into a benzene concentrate, a toluene concentrate, and a xylenes-containing stream which is used in aviation gasoline.





FEED "PREPARATION" for aromatics unit takes place in this Platformer

Table 1—Composition of Platformer Feed and Product

Key Components, Vol. %, basis feed	Feed	Stabilized Product
Cyclopentane	0.1	0.05
Methylcyclopentane	7.6	4.6
Cyclohexane	7.0	0.3
Benzene	2.4	10.0
Dimethylcyclopentanes	7.2	0.9
Methylcyclohexane	8.9	0.1
Toluene	3.9	17.5
C_8 Naphthenes and Aromatics*	4.8	3.8

*Includes: ethylbenzene, xylenes, dimethyl and trimethyl cyclopentanes, etc.

Benzene and toluene are recovered in separate, essentially identical, extractive distillation systems. Each concentrate, after exchange with hot phenol, enters its extractive distillation tower, where the non-aromatics are removed overhead as raffinate.

The phenol solvent, watercooled after having heated the hydrocarbon feed, enters near the top of the column, passes down through the tower and, together with the benzene or toluene, out the bottom and into the solvent distillation column. Here the aromatic is conventionally distilled away from the phenol, which is recirculated to the extractive distillation column.

Solvent circulation and reflux return to the extractive distillation column are maintained at rates which will insure such a solvent concentration on the trays, that the volatility differences between aromatic and non-aromatics are sufficient to permit the desired recovery with the trays available.

The trays above the solvent inlet form the "knock-back" section, which keeps the loss of phenol to raffinate to a minimum.

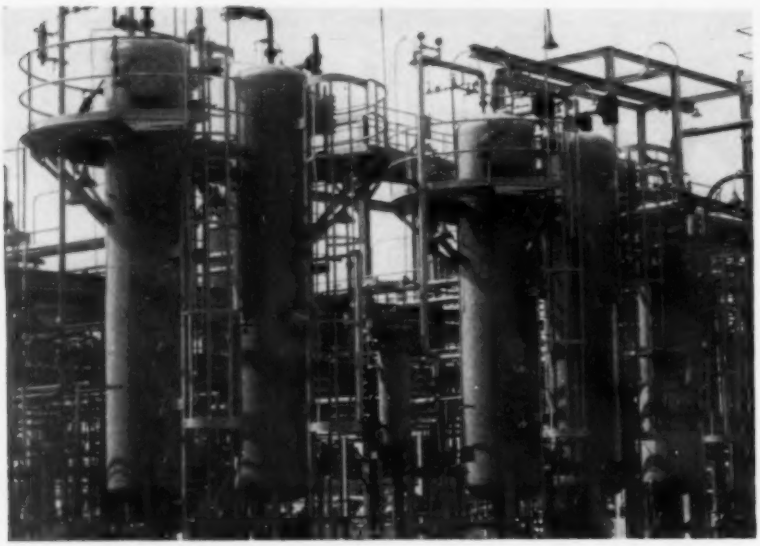
Following solvent recovery, benzene is treated successively with sulfuric acid, caustic and a water wash. Polymers and sulfonate sludges are then separated in a rerun tower.

The final operation is drying with calcium chloride. Two 2,500-bbl. tanks have been provided to hold production of benzene until precision laboratory tests on a full tank confirm that it meets specifications.

Should there be an upset anywhere in the benzene recovery chain, a 5,000 bbl, off-specification material tank is also available and manifolded to several parts of the unit; accumulations of off-specification material are returned to the unit at a suitable place in the flow scheme.

No sulfuric acid treating is provided for toluene. Instead, acid wash color is controlled by treating with maleic anhydride, followed by a caustic treat, water wash, and calcium chloride drying.

Inspections of the benzene and



AROMATICS PRODUCTS come from these concentration and extraction towers

toluene products are shown in Tables 2 and 3.

Carbon steel tubes are used in heaters and all reboiler bundles where phenol is not anticipated. In phenol service, tubes and sheets are 18-8 stainless steel. "Worthite" trim is used for pumps and 18-8 stainless steel in valves in phenol service. Other valves are trimmed with 11-13% chrome stainless. Carpenter "20" and Hastelloy "D" and "B" trim is used in pumps handling sulfuric acid and maleic anhydride.

The Platformer is one of the largest yet to be constructed, being rated for 16,000 b/sd of straight run naphtha, using a 6:1 mol ratio of hydrogen to feed, when Platforming for octane number improvement of gasoline, as originally intended.

Each compressor (Clark centrifugal type) was designed for horsepower loading at a capacity of 125,000 MCFD of gas containing 70% hydrogen at a suction pressure of 650 psig and a discharge pressure of 900 psig developing 2,775 hp. Normal operation is at about 90% hydrogen purity. (The maximum speed is 11,400 rpm, developing 2,950 hp.)

As the plant developed, the critical need for benzene and toluene made it desirable to convert to the manufacture of these aromatics. Operation at the lower pressure required for aromatics production made it necessary to revamp the compressor flow scheme. Thus the second centrifugal compressor (a spare in naphtha operation) is now operated in series with the first to obtain the necessary compression ratio.

Other than this, the original Platformer design was not changed. The alloy steel used follows conventional practice and is principally confined to the reactor section including furnace tubes, piping, and exchangers.

For aromatics production, the Platformer charge rate is 13,000 b/sd, composed of a solutizer-sweetened straight run gasoline from which about 85% of the mercaptans have been removed, and a sweet gasoline formerly used for aviation base stock. Typical feed and product compositions are shown in Table 1.

The operation and basic construction of this unit are conventional, with the usual four reactors and charge reheating between reactors. The net gas off the product separator, which is largely hydrogen, and the minor quantity of gas overhead from the product stabilizer are run through an absorber from which the overhead is 95% hydrogen. Liquid make is returned to the stabilizer. The principal reason for this arrangement is that aromatics which might be otherwise lost in flashing the reactor product are recovered in the rich oil.

Recycle gas to the Platformer is scrubbed with 20°Be′ caustic to remove hydrogen sulfide, water washed to remove entrained caustic, and contacted with diethylene glycol for dehydration.

An unusual feature of the Platforming unit is the use of nitrogen as reactor purge gas instead of flue gas or some other means. Unfortunately, carbon monoxide which might be in flue gas exerts a poisoning effect upon the catalyst and steam is undesirable for several reasons. Comparative installation and operating cost studies were made between an inert gas generator and pure nitrogen, purchased in high-pressure cylinders on wheeled trailers. The result was definitely in favor of the latter.

Accordingly, two trailers carrying enough cylinders to each provide 40,000 SCF of nitrogen under 2,000 psig pressure are always parked to one side of the unit. This represents a large safety factor since only 8,000 SCF are required to fill the reactor system. The manifolding allows withdrawal from only one trailer at a time, and each will fill the reactor system at least four times before recharging.

Table 2—Inspection of Benzene

Test	Typical Property	Method
Specific Gravity @ 15.5°C	0.8800	ASTM D891
Color	Pass	D853
Distillation Range:		
IBP, °C	79.5	D850
D.P., °C	80.4	D850
Solidifying Point, °C	5.05	D852
Acid Wash Color	1	D848
Acidity	Nil	D847
Sulfur Compounds	Nil	D853
Copper Corrosion	Pass	D849

Table 3—Inspection of Nitration Grade Toluene

Test	Typical Property	Method
Insoluble Material, %wt.	Nil	JAN-T-171 Amendment 2
Color	Pass	"
Sulfur Content	Nil	
Paraffin Hydrocarbons, %vol.	0.6	"
Specific Gravity @ 15.5°C	0.8704	ASTM D891 Westphal Balance
Acidity	Nil	JAN-T-171 Amendment 2
Separated Water	Nil	"
Cloud Point	Below 30°C	"
Dryness	Pass	"
Acid Wash Color	1+	"
Copper Corrosion	Pass	"
Distillation Range:		"
IBP, °C	110.0	"
D.P., °C	110.9	

Do You Know These Words?

By B. H. WEIL
Manager, Information Services
Ethyl Corp. Res. & Engrg. Dept.
Detroit, Mich.

A regular department intended to help administrators and operating men alike keep abreast of technical names and processes in the petrochemical field.

Alpha-Hydroxyadipaldehyde

Alpha - Hydroxyadipaldehyde, pronounced **"al**-fah-high-**drahk**-se-**add**-ip-**al**-dee-hide," is a petrochemical of the second or third generation; that is, it is derived from chemicals which in turn are prepared from other petrochemicals. It has the formula $OHC{\cdot}CH_2{\cdot}CH_2{\cdot}CH(OH){\cdot}CHO$, in which the first and last groups are "aldehyde groups" and a "hydroxy group" (OH) appears in the "alpha" position. The material is colorless liquid with a sharp odor, and is supplied commercially as a 25% solution in water to inhibit formation of a white, insoluble polymer. As a solution it is mild-odored and relatively nonvolatile.

Alpha-hydroxyadipaldehyde is a derivative of the petrochemical, acrolein. It is a new commercial dialdehyde that is of increasing interest for the preparation of synthetic resins, as an "insolubilizing agent" for proteins and polyhydroxy materials, and as a cross-linking agent for polyvinyl acetal type resins. It should prove useful for shrink-proofing and imparting crease resistance to textiles such as rayon and cotton. As an insolubilizing agent it is also of interest in the manufacture of gaskets and matches, washable wallpaper, dextrin glues, paper coatings, and in the hardening and tanning of hides.

Acrolein, the base material for this substance, is itself produced by a series of steps either from propylene or from ethylene and natural gas, depending upon the process used. The first two of these raw materials are themselves obtained from refinery cracked gases or produced from LPG.

Petrochemicals are becoming legion in number, but each new one is scrutinized carefully by consumer industries. They will determine the future of alpha-hydroxyadipaldehyde.

Styrene Oxide

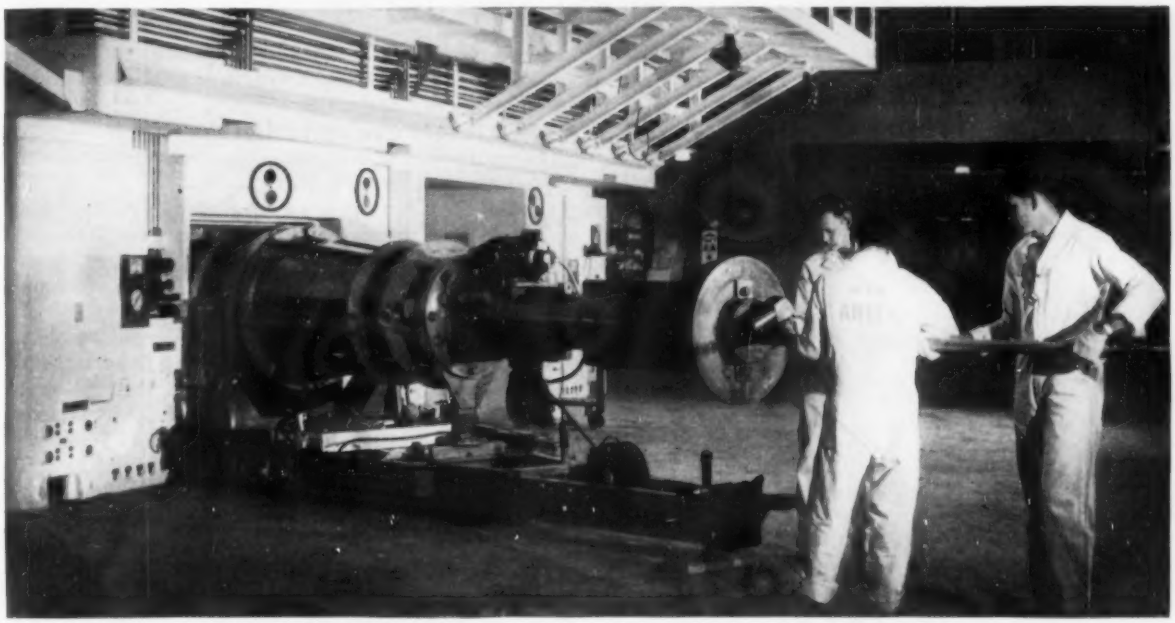
Styrene Oxide, pronounced **"sty**-reen **ock**-side," is a petrochemical which is of interest because of its "epoxy" group and because it also contains the benzene ring. A toxic, colorless liquid with a sharp characteristic odor, it weighs about the same as water but boils at a considerably higher temperature. It has the formula $C_6H_5{\cdot}CH_2{\cdot}CH_2$.

An industrial chemical for the past six years, styrene oxide is derived from benzene and ethylene via styrene. Its first use was in a new synthesis for phenylethyl alcohol, the synthetic "oil of roses." A more recent use is in the preparation of plastics, particularly as a reactive diluent in the synthesis of epoxy resins for electrical insulation and structural pipe. Other uses fall in the fields of surface-active agents, plasticizers, pharmaceutical intermediates, and antioxidants.

As mentioned repeatedly in this series, benzene and ethylene are large-volume petrochemical building blocks. Benzene is extracted from catalytic reformates, while ethylene is separated from refinery cracked gases or produced by cracking ethane or propane (from LPG or LRG). The intermediate product, styrene, is a high-tonnage petrochemical used in the synthetic rubber (GR-S) and plastics (polystyrene) industries.

"Epoxy" ("epoxide") chemicals are now of considerable interest, and some of them will probably find high-volume use. This is not a certainty for styrene oxide, but this chemical does have many interesting possibilities.

NEWS IN VIEWS



OIL COMPANY ATOMIC TECHNOLOGISTS. The specialized facilities of the Materials Testing Reactor operated by Phillips Petroleum Co. at Idaho Falls, Idaho, for the Atomic Energy Commission have now been made available for public use on a limited basis by the AEC. Phillips will continue its supervision of this new service designed to further AEC aims of greater utilization of the benefits from atomic energy developments.

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Roselle, New Jersey

2

FOR LIQUID WASTE—an ancient device, the roman candle

FOR VAPOR WASTE—the most modern device, a flare stack

THE OLD AND THE NEW . . .

A Solution to a Hydrocarbon Waste Problem

HISTORY tells us that fireworks' development dates back to some time in the 17th century, a long time ago for an invention that still has use today.

Dow Chemical Co.'s Texas Division has coupled this ancient invention with more modern equipment in a two-pronged attack on the problem of hydrocarbon waste disposal at its Freeport plant.

The problem, similar to many being met by other plants in the petroleum processing industries, consisted of minimizing the inky black smudge which arises during process upsets when it is necessary to flare the light hydrocarbons vented from vessels.

The solution consists of an installation comprising an underground separator tank, a burning pit for liquids, and a flare stack for vapors. The 300-year-old fireworks are used on the pit: the latest ignition equipment is used on the stack.

The heart of the system is the underground tank, which separates slugs of liquid from the vapors being vented from the processes. The vapors are relieved from the top of the tank to the flare stack. This stack is equipped with a ring of finger-like jets which inject steam into the vapor at the top outlet, thus atomizing it for burning with a minimum of smoke. An electric igniter, with a ground-level manual switch, is used in case the pilots are blown out.

The fireworks are used in the form of a roman candle, providing a handy and safe means for igniting the liquid waste hydrocarbons whenever it becomes necessary. Liquid hydrocarbons trapped in the separator tank collect and then overflow into an open brick-lined pit, located near the flare stack and well away from the Freeport process area. No attempt was made to equip this pit with a pilot light or any form of automatic ignition. Instead, whenever it is considered necessary, an employe lights off the accumulation in the pit with a roman candle.

Dow supervisors got a lot of kidding when they ordered the roman candles, but they have found the ancient invention a very practical solution to what could be a hazardous job.

Smoke is not eliminated completely with the new stack and pit installation, but the company has noticed a considerable improvement in cutting down on the air-polluting smoke.

How to Prepare for Metallizing

HERE'S a suggested solution to a problem involving the use of metallizing techniques to protect moving surfaces from wear corrosion. It is based upon information developed during a conference for several Canadian oil companies and International Nickel Co. of Canada.

It was prepared for PETROLEUM PROCESSING by John F. Mason, Jr., corrosion engrg. section, development and research dept., International Nickel Co., New York.

Problem: How effective is the practice of metallizing pump shafts and cylinders in refineries, and what is the surface preparation necessary in this procedure?

Suggested solution: Metallizing is probably the simplest and most widely used method for building up worn shafts and cylinders of all sizes. However, this metal spraying method is not recommended generally for protecting base metal with a more noble or an alloy sprayed coating, because of the porous structure of the latter.

Furthermore, for some purposes,

this porosity imposes a limitation on the use of sprayed metals because it weakens the tensile strength and toughness of the coating. Consequently, metal spraying cannot strengthen and stiffen a built-up section as does welding.

When worn shafts are built up by the metallizing method, however, the porous structure of the sprayed metal provides one definite advantage. This is in the exceptionally good bearing qualities of sprayed metal coatings. The pores fill up with lubricant and exude it over the bearing surface when the shaft is in service. The effect of this oil film in minimizing friction is the reason for the remarkably long service records reported for metal wearing surfaces.

The success of any metal spraying depends on securing a good bond between the base metal and the sprayed metal. Since the sprayed metal particles chill too rapidly to fuse with the base metal, the coating must be keyed or dovetailed into the shaft to provide a mechanical anchorage.

First, the worn section is machined to clean up the worn surface and provide for the proper thickness of metallized coating. Machining should be done dry—the metal surface must be kept perfectly clean to produce a good bond.

Secondly, the machined surface is grooved or cut with a rough thread of approximately 24 to the inch.

Thirdly, the grooved edges are roughened and spread to form dovetail keys, by running a rotary shaft preparing tool across the machined section.

Since any oil, dust, or even fingerprints on the prepared surface can impair the bond, it is advisable to metallize a shaft soon after the preparation is finished. The first few passes are made with the gun held at an angle to do the work, alternately spraying from each side, in order to deposit the sprayed metal underneath the dovetails. Then the gun is mounted in the tool post holder with the nozzle 6 in. from the work, and the balance of the coating is applied at a 90° angle to the work.

The built-up coating is tightly anchored to the shaft by the dovetail keys and the tensile strength of the bond is practically equal to the strength of the coating. After being built up, the sprayed section may be finished to size by grinding or machining and lapping with No. 00 emery cloth.

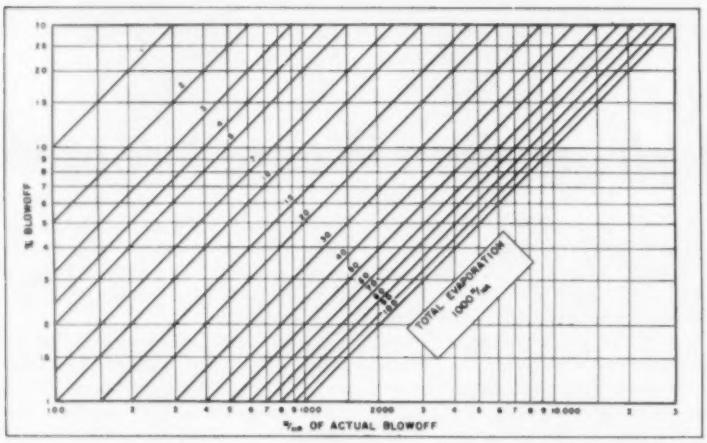


FIG. 1—Percent blow-off, total evaporation, and lb/hr of blow-off

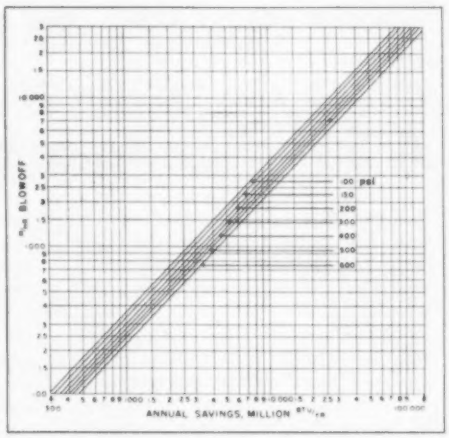


FIG. 2—Lb/hr of blow-off, boiler pressure, annual savings

Continuous Blow-off Will Save Btu's

By V. J. Calise*

EVERY boiler plant operator has to take precautions to recover waste heat to reduce his operating costs. The practice of intermittent and manual blow-off—even on very small or low pressure boilers—is intolerable in the face of present day high fuel and labor costs.

For any given boiler plant, a simple four-step procedure—using the accompanying table and curves—will calculate in a few seconds the annual savings in Btu's resulting from heat recovery through continuous blow-off.

Step 1—Determine the total dissolved solids (TDS) in the makeup water, in ppm. Choose the allowable concentration in the boiler in ppm. from the following table (based on ABAI standards) for maximum permissible TDS in boiler water for various pressures:

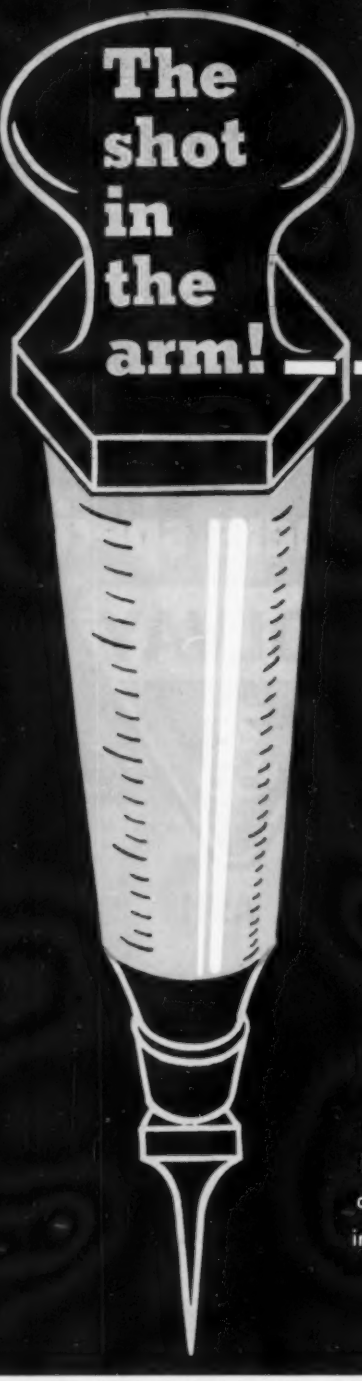
Boiler pressure psig.	Total dissolved solids, ppm.
0- 300	3500
301- 450	3000
451- 600	2500
601- 750	2000
751- 900	1500
901-1000	1250
1001-1500	1000

The suggested limits sometimes recommended by authorities for maximum permissible silica concentration in boiler water for various pressures are:

Boiler and Turbine Operating pressure psig.	max. Silica in Salines ppm. as SiO_2
250- 600	40-50
601- 900	20-30
901-1200	10-20
more than 1200	less than 1
more than 1800	less than 5-10

For high-pressure boilers, particularly where turbines are used with condensers for very low-pressure steam discharge, the maximum per-

* Mr. Calise is director, research and development, Graver Water Conditioning Co.



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Applications? Whenever heat must be controlled: for boiler settings, oil stills, cat crackers, metallurgical furnaces, driers, kilns, incinerators. You can get more information on how to give your "coming up" installation a shot in the arm if you write—today!

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missible silica concentration in the boiler water is usually set by the power engineer or consultant so that there will be no danger of turbine blade silica deposits.

These values are subject to change based on operating experiences in the field and new experimental data.

Step 2—From Table 1, find the percent blow-off of the total evaporation. This Table 1 is based on 100% makeup. If the makeup is less than 100%, use the following formula to calculate the blow-off in lbs./hr.

$$B = [M_{so}/(TDS_m - M_{so})]M_e$$

where: B = blow-off
M_{so} = makeup solids
TDS_m = *max. allowable boiler TDS*
M_e = makeup for evaporation

Example

Boiler pressure	= 475 psi.
Total evaporation	= 100,000 lbs./hr.
Makeup solids	= 250 ppm.
Blow-off solids	= Max. allowable boiler TDS = 2500 ppm (according to standards).
Condensate returns	= 50% of total evaporation. = 50,000 lbs./hr.
Makeup for evap'n	= 50,000 lbs./hr.
Blow-off	= [250/(2500—250)] 50,000 = 5550 lbs./hr.
Total makeup	= Makeup for evap'n + blow-off. = 55,550 lbs./hr.
Feedwater	= Condensate return + total makeup. = 105,550 lbs./hr.

For determining the blow-off based on maintaining a given silica concentration in the boiler salines with a given silica concentration in the treated makeup, use the following formula:

$$B = [M_{si}/(Si_m - M_{si})]M_e$$

where: B = blow-off
M_{si} = makeup silica
Si_m = max. allowable silica
M_e = makeup for evaporation

Step 3—Using the curve in Fig. 1 and knowing the total evaporation, determine the actual lbs./hr. of blow-off.

Step 4—Using the curve in Fig. 2 and knowing the boiler pressure, determine the approximate annual savings in millions of Btu. The actual dollar savings per year can then be calculated for each plant. Thus curve is based on 75% boiler efficiency. For other efficiencies, multiply the result by the proper ratio.

Example

Boiler pressure	= 400 psi.
TDS in makeup water	= 90 ppm.
Amount of makeup	= 100%
Total evaporation	= 50,000 lbs./hr.
Allowable concentration	= 3,000 ppm.
Blowdown (from Table 1)	= 3.1%
Blowdown (from Fig. 1)	= 1,550 lbs./hr.
Annual savings (from Fig. 2)	= 5,500,000,000 Btu/yr.

Table 1—Total Dissolved Solids, Allowable Concentrations, and Percent Blow-Off

(based on 100% makeup)

TDS Makeup	% Blowoff of total evaporation Allowable concentration, ppm						
ppm.	1000	1250	1500	2000	2500	3000	3500
10	1.0	0.8	0.7	0.5			
15	1.5	1.2	1.0	0.8	0.6	0.5	
20	2.0	1.6	1.4	1.0	0.8	0.7	0.6
25	2.6	2.0	1.7	1.3	1.0	0.8	0.7
30	3.1	2.5	2.0	1.5	1.2	1.0	0.9
40	4.2	3.2	2.6	2.0	1.6	1.3	1.1
50	5.3	4.2	3.4	2.6	2.0	1.7	1.4
60	6.4	5.0	4.2	3.1	2.5	2.0	1.7
70	7.5	5.9	4.9	3.6	2.9	2.4	2.0
80	8.7	6.8	5.6	4.2	3.3	2.7	2.3
90	9.9	7.8	6.4	4.7	3.7	3.1	2.6
100	11.1	8.7	7.2	5.3	4.2	3.4	2.9
125	14.3	11.1	9.1	6.7	5.3	4.3	3.7
150	17.7	13.6	11.1	8.0	6.4	5.3	4.5
200	25.0	18.8	15.4	11.1	8.7	7.2	6.1
250		25.0	20.0	14.3	11.1	9.1	7.7
300			25.0	17.6	13.6	11.1	9.4
400				25.0	19.0	15.4	12.9
500					25.0	20.0	16.7
600						25.0	20.6
700							25.0

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YOU get the highest possible accuracy of reading on low temperature, low boiling point liquids with the patented Jerguson Non-Frosting Gage in the New Large Chamber model . . . because it insures less turbulence at the meniscus, and clear vision at the vision slot.

This new Jerguson model has 6 times larger area at the meniscus than the standard gage, so that there is a marked reduction in turbulence with light gaseous fluids that tend to boil or surge. Moreover, the problem of frosting encountered with these liquids has been eliminated by a patented frost preventing unit extending from the gage glass. This special transparent unit projects beyond the cover bolts and prevents frost from building up over the vision slot.

Here's a dual feature gage that assures greatly increased accuracy of reading for the process industries. If you have a problem with light gaseous fluids, or with gage frosting, it will pay you to investigate the new Jerguson Large Chamber Non-Frosting Gage . . . reflex or transparent.

Jerguson Large Chamber Gage, Transparent Type, with the patented Non-Frosting Gage Glass Extension. Write for literature on this gage, and on other non-frosting Jerguson models.

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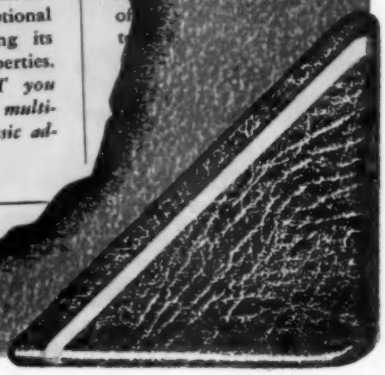
New Grease Thickener...
Estersil GT
by Du Pont

A new type of grease thickener—quite different from any previously used in commercial grease production—was recently announced by the Petroleum Chemicals Division of the Du Pont Company.

The new material, an estersil, is a pelletized form of finely divided amorphous silica with a "raincoat" chemically attached to each tiny ultimate particle.

Formerly known as PL-171 FINE SILICA, it is completely synthetic and was specially developed for grease compounding. "Built-in" water resistance and exceptional thermal stability are among its unusual and outstanding properties.

NOW—with Estersil GT you can easily prepare a unique multi-purpose grease with the basic advantages listed below . . .



1. Excellent Thermal Stability—Nonmelting Estersil GT greases show little change in consistency over a wide range of operating temperatures.

2. Excellent Shear Stability—This new thickener enables you to make greases with exceptional shear stability under *both* normal and *high* temperature conditions.

3. Water Resistance—The chemically bonded "raincoat" means greases with unusual resistance to wash out or break down in the presence of water.

4. Superior Oxidation Stability—The need for grease antioxidants is eliminated under most service conditions because of the inertness of Estersil GT.

5. Superior Handling Qualities—Softer, more easily applied greases can be used for high temperature service because of the combined mechanical and thermal stability imparted by Estersil GT. These softer greases, of course, are more readily handled at low temperature than the more conventional types.

6. Ease of Manufacture—The completely synthetic preformed thickening structure allows reproducible grease preparation through a simple milling operation.

Du Pont will be glad to send a representative to discuss the formulation of improved greases with Estersil GT. A grease pilot plant is available to assist in this work. Samples of Estersil GT may be obtained by addressing your inquiry to Wilmington, Delaware.

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(*To obtain more data on advertised products see page 1260*)

By Peter J. Gaylor, Patent Attorney, Elizabeth, N. J.

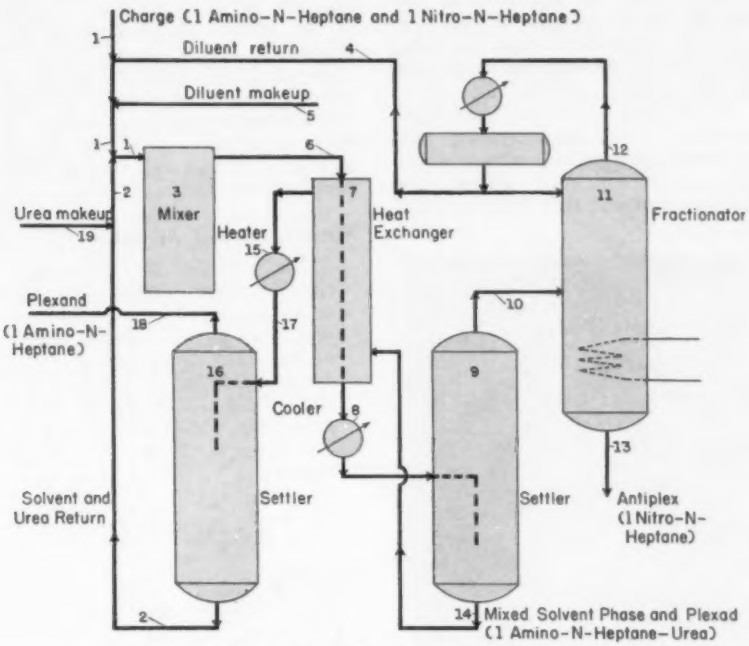


FIG. 1—Separation of hydrocarbon derivatives by use of urea

Processes Developed Using Urea For Separation of Hydrocarbons

JUDGING by the number of patents being issued on separation processes employing urea, it can be assumed that considerable effort is being devoted by oil companies in this direction.

In the case of Socony Vacuum Oil Co., Inc., for example, the work has progressed to a point where it has been necessary to devise a new vocabulary specific to this field. For example, the name "plexad" is used to designate a revertable associated complex comprising a plexor, such as urea, and at least one other compound. Said plexad is characterized by reverting or decomposing under the influence of heat and/or various solvents, to its original constituents, namely a plexor and at least one "plexand."

A "plexand" is defined as a compound capable of forming a plexad with a plexor, such as urea. Compounds of this character differ in their capacity to form plexads, depending upon various factors. An "antiplex" is a compound incapable of forming a plexad with a plexor, while a "plexor" is a compound capable of forming a plexad with a plexand, such as urea. "Plexation" is the act, process, or effect of "plexating."

In U.S. Patent 2,681,333, issued to Socony-Vacuum Oil Co., Inc., the discovery claimed is that, by selective plexation with urea, a terminally substituted straight chain compound can be separated, in the form of a plexad, from a mixture containing the same and another terminally substituted straight chain compound containing a different substituent than the first but having the same number of carbon atoms. The "width" of the terminal substituent of the first compound must be less than the "width" of the terminal substituent of the second compound.

Selective plexation also is effective in many cases when the terminal substituents are different, and the number of carbon atoms of the substituted paraffins are different. The patent gives data correlating the "width" of the terminal group and the minimum chain length for urea plexation at a given temperature.

Fig. 1 illustrates a typical flow chart used, for example, for separation of 1 amino-n-heptane and 1-nitro-n-heptane. This charge enters through line 1 and is contacted with urea solution from line 2 and intimately mixed in mixer 3. If the charge is too viscous, a diluent such as naphtha may be recycled through the process and introduced through line 4.

From mixer 3, the charge is fed through heat exchanger 7, cooler 8 and settler 9. Although some plexad (amine-urea) may be formed in the mixer 3, it is preferable to operate the mixer at a temperature somewhat higher than that required for plexad formation. From cooler 8, the plexad-containing mixture flows into settler 9 in which the top layer is antiplex (1-nitro-n-heptane), the intermediate layer is urea solution, and the lower slurry region is the plexad in urea solution.

The incoming mixture preferably is introduced into the solution phase, so that the antiplex may move upwardly and the plexad downwardly, through some little distance in the solution, to permit adequate separation of plexad from antiplex and antiplex from plexad.

Antiplex is removed from settler 9 by line 10 and introduced into fractionator 11, where diluent is removed, passed overhead through vapor line 12 and reused eventually. Recovered antiplex passes from the system through line 13. Plexad and urea solution drawn from settler 9 through line 14 are passed through heat exchanger 7 and heater 15 to enter settler 16 through line 17. In this operation, the temperature is so adjusted that the plexand (amine) is freed from the plexad, and in settler 16, the plexand rises to the top to be recovered via line 18. The urea solution, thus reconstituted to its original condition by return to it of that portion of the urea which passed into the plexad, is withdrawn from settler 16 by line 2 and returned to the process.

Preventing Cloudiness in Refined Lubricating Oils

WHEN refining lubricating oils containing small amounts of paraffin waxes which are solid at normal temperature it sometimes happens that a part of these waxes does not remain completely dissolved in the refined oil but precipitates at temperatures up to 50° C. above the solidifying point of the oil itself, the precipitated waxes forming "snowlike" flocs or clusters in the oil.

The total quantity of the precipitated

paraffin wax is often very small, about 0.01% of the weight of the oil, and it is technically of no importance for the function of the oil as a lubricant, since the solidifying point of the oil per se is low. However, the cloudiness tends to give the impression of inferior quality of the oil.

According to Patent 2,674,578 issued to the Swedish firm of A. Johnson & Co., this disadvantage is obviated by adding to the refined lubricating oil small amounts of high molecular resinous polar substances capable of forming, with the molecules of the paraffin waxes present in the oil, molecular complexes which are soluble in the oil, whereby the occurrence of cloudiness is prevented.

It has been found that such high-molecular cloudiness-preventing substances are present in raw montan wax and can be recovered therefrom by extraction of the wax with aromatic hydrocarbon solvents, such as toluene. The extract thus obtained may either be used as it is, or after removal of the solvent, for example by distillation.

About 0.05-0.001% by weight of the oil to be treated is used. The lubricating oil thus treated is claimed to remain completely clear for several months at 20° C. and even at lower temperatures.

Patents Issued in June

The following classified listing gives the patent number, patentee, or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazette of the U.S. Patent Office for June, 1, 8, 15, 22, and 29, 1954, Vol. 683, Nos. 1-5.

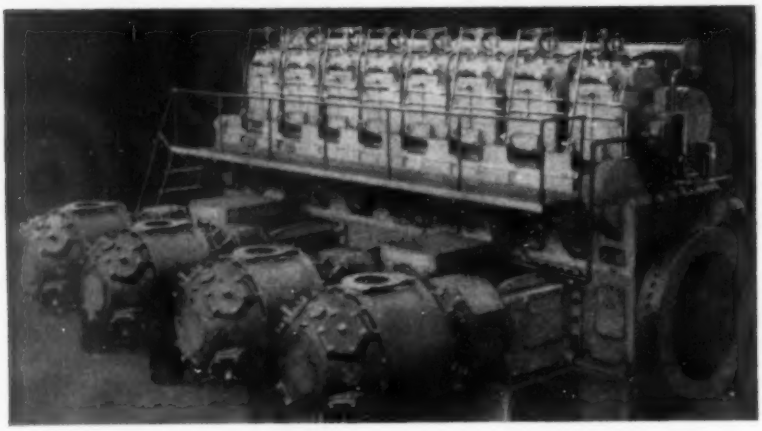
PROCESSES

Refining

2,680,278 (Phillips Petroleum Co.) Alumina pebble having high resistance to attrition.
2,680,675 (Phillips Petroleum Co.) Fluid-solid contacting tower.
2,680,676 (Phillips Petroleum Co.) Heat exchange apparatus.
2,680,692 (Phillips Petroleum Co.) Stabilized alumina heat exchange pebble.
2,681,125 (Standard Oil Development Co.) Process for removing dust and condensable vapors from gases.
2,681,218 (Standard Oil Development Co.) Reduction of entrainment in bubble cap towers.
2,681,301 (Standard Oil Development Co.) Process for removal of complex high molecular weight aromatic constituents from high boiling oils with CCl_4, etc.
2,681,302 (Socony-Vacuum Oil Co.) Separation of hydrocarbons and hydrocarbon derivatives, using urea, etc.
2,681,303 (Socony-Vacuum Oil Co.) Separation of hydrocarbons and hydrocarbon derivatives by adduct formation with urea, etc.
2,681,333 (Socony-Vacuum Oil Co., Inc.) Separation of hydrocarbons and hydrocarbon derivatives, using plexand (1-amino-n-heptane), urea, antiplex (1-nitro-n-heptane), etc.
2,681,335 (Socony-Vacuum Oil Co., Inc.) Separation of hydrocarbons using urea complex.
2,681,336 (Socony-Vacuum Oil Co., Inc.) Separation of sulfur-containing compounds by urea adduct formation.
2,681,337 (Socony-Vacuum Oil Co., Inc.) Triethylamine as a solvent in urea complex formation.
2,681,356 (Standard Oil Development Co.) Extraction of oxygenated compounds from oils with aqueous salt solutions of oil soluble carboxylic-acid with 3-12C.
2,681,904 (Phillips Petroleum Co.) Separation process, using urea, etc.
2,682,395 (Shell Development Co.) Divided downcomer for trays of fractionating columns.
2,682,444 (Hunphreys & Glasgow Ltd.) Continuous process for the removal of hydrogen sulfide from gas, using moving bed of hydrated iron oxide.
2,682,452 (U.S. Aatomic Energy Com.) Apparatus for liquid-liquid extraction.
2,682,453 (U.S. Atomic Energy Com.) Mixer-settler contact apparatus.
2,682,494 (Standard Oil Development Co.) Deasphalting of air blown oil used as cracking feed.
2,682,496 (Standard Oil Development Co.) Deashing residual oils with an acid of phosphorus.

Catalysts

2,680,099 (Universal Oil Products Co.) Manufacture of alumina spheres.
2,680,100 (Davison Chemical Corp.) Manufacture of silica-magnesia catalyst.
2,681,305 (Standard Oil Development Co.) Revivification of a silicious cracking catalyst by treating with fluosilicic acid.
2,681,374 (Standard Oil Development Co., Elizabeth, N.J.) Control of phosphoric acid catalyst hydration.



How one refinery eliminated scale build-up in compressors

Oakite Airefiner No. 52 prevents scale formation— cuts downtime, maintenance

Every 6 to 8 weeks a Southwestern refinery had to run acid through compressor water jackets to remove thick lime scale deposits. That meant compressors down for half a day. What could Oakite do?

The Oakite Man first descaled the jackets with Oakite Compound No. 32. Then he charged the spray pond with Oakite Airefiner No. 52, and set up a schedule for maintaining proper pH in the solution.

Results: Manifold temperatures reduced — no more descaling, no more cracked blocks or heads, no more compressor downtime.

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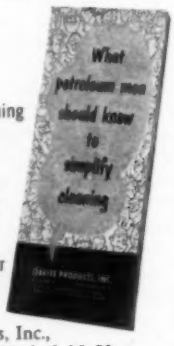
Cleaning tank car interiors



Write Oakite Products, Inc., 50D Rector St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE
petroleum service division
Technical Service Representatives in Principal Cities of U. S. and Canada

 (*To obtain more data on advertised products see page 1260*)

Conversions

2.680.065 (The Texas Co.) Gasification of carbonaceous solids in fluidized system.
2.680.091 (Standard Oil Development Co.) Preheating of oil shale for distillation in fluidized system.
2.680.706 (Phillips Petroleum Co.) Device and method for preventing carbon laydown during hydrocarbon conversion.
2.681.273 (Standard Oil Development Co.) Process for making combustible gas in checkerwork, using fluidized mass of coal.
2.681.304 (Standard Oil Development Co.) Cracking of hydrocarbon oils with selected porous silica-alumina.
2.681.373 (Sun Oil Co.) Catalytic alkylation of aromatic hydrocarbons.
2.681.834 (Sun Oil Co.) Conduit for elevating contact material.
2.682.459 (Harold Stanier) Process for producing combustible gases Methane, hydrogen and CO from hydrocarbon oils, using catalyst.
2.682.494 (Standard Oil Development Co.) Hydroforming process, in presence of carboxylic acids.
2.682.497 (Phillips Petroleum Co.) Pebble heater and method of converting hydrocarbons.
2.682.531 (Standard Oil Development Co.) Zirconium tetrachloride-ether complexes as low temperature polymerization catalyst.

Hydrocarbon Synthesis

2.680.125 (Metallgesellschaft Aktiengesellschaft) Catalytic hydrogenation of carbon monoxide to produce hydrocarbons and oxygenated hydrocarbons.
2.680.126 (The Texas Co.) Method of effecting the hydrogenation of carbon monoxide using suspended catalyst particles.
2.681.272 (M. W. Kellogg Co.) Method for manufacture of a gas rich in hydrogen (CO).
2.681.852 (The Texas Co.) Method for partial combustion of carbonaceous materials to produce CO and hydrogen.
2.681.924 (Stanolind Oil & Gas Co.) Method for increasing yield of water-soluble chemicals in hydrocarbon synthesis.
2.682.552 (Standard Oil Development Co.) Hydrocarbon synthesis process using Fe catalyst.

PRODUCTS

Chemicals

2.680.138 (Phillips Petroleum Co.) Process for preparing tertiarybutyl isopropybenzene hydroperoxide.
2.680.139 (Societe des Usines Chimiques Rhone-Poulenc) Process for the preparation of hydroperoxides of benzene hydrocarbons.
2.680.752 (Shell Development Co.) Process and catalyst for producing olefin oxides from olefin and oxygen with silver catalyst.
2.680.756 (Du Pont Co.) Dicyclopentadienyliron and process for making the same.
2.680.757 (Richfield Oil Corp.) Catalyst recovery process from xylene oxidation.
2.680.758 (Du Pont Co.) Dicyclopentadienyl nickel and method.
2.680.759 (Socony-Vacuum Oil Co., Inc.) Paraffin wax monothiocyanate.
2.680.763 (Du Pont Co.) Preparation of products derived from carbon monoxide and mono-olefins and halogens, etc.
2.681.332 (Socony-Vacuum Oil Co., Inc.) Separation of amines by urea complex formation.
2.681.334 (Socony-Vacuum Oil Co., Inc.) Formation of urea complexes with compounds containing a monocyclic substituent, using plexand t-bromo-n-octane), urea, etc.
2.681.357 (The Texas Co.) Process for producing a wax oxidate of high ester content.
2.681.362 (Sun Oil Co.) Alkyl substituted benzene sulfonate.
2.681.368 (Standard Oil Development Co.) Removal of cobalt and iron from oxo aldehydes.
2.681.369 (The Texas Co.) Separation of phenols from thiophenols.
2.681.371 (Universal Oil Products Co.) Production of ortho substituted hydroquinones.
2.681.372 (Ethyl Corp.) Manufacture of ethyl chloride and vinyl chloride.
2.681.882 (Stanolind Oil & Gas Co.) Azeotropic distillation of alcohols from methyl n-butyl ketone.
2.681.901 (Shell Development Co.) Glycidyl-polyether resin-forming compositions containing amine salts of fatty acids.
2.681.903 (Standard Oil Co.) Polymerization of iso-olefins in cycloparaffin diluents.
2.681.920 (Shell Development Co.) Preparation of phosphonates.
2.681.921 (Union Oil Co. of Calif.) Preparation and polymerization of derivatives of alpha-hyroxy acids and estolides.
2.681.930 (Lion Oil Co.) Manufacture of urea.
2.681.935 (Universal Oil Products Co.) Stabilization of aryl amino compounds.
2.681.940-1 (Dow Corning Corp.) Fluorinated pentenes.
2.681.942 (Dow Corning Corp., Midland, Mich.) Fluorinated diene.
2.682.447 (Phillips Petroleum Co.-Del.) Process for production of hydrogen cyanide and acetylene, using ceramic pebble heater.
2.682.498 (Standard Oil Development Co.) Treatment of sulfuric acid sludges containing aromatic sulfonic acids.
2.682.514 (Shell Development Co.) Compositions containing glycidyl polyether of a polyhydric phenol and an epoxidized ester.
2.682.515 (Shell Development Co.) Adhesive composition containing polyepoxide materials.
2.682.529 (Phillips Petroleum Co.) Emulsion polymerization of vinylidene compounds in the presence of hydroperoxides of octahydrophenanthrenes.
2.682.530 (Phillips Petroleum Co.) Cyanates and thiocyanates as activators for heavy metal free emulsion polymerization system.
2.682.545 (Phillips Petroleum Co.) Chlorination of dihydrothionaphthene sulfone.
2.682.553 (Continental Oil Co.) Oxidation of hydrocarbons.
2.682.554 (Phillips Petroleum Co.) Preparation of trialkyl trithiophosphites.

Fuels

2.679.730 (Maschinenfabrik Esslingen) Handling of liquefied gases.
2.679.746 (Phillips Petroleum Co.) Detonation analyzer.
2.681.053 (California Research Corp.) Starting of internal-combustion engines with priming fuel capsule.
2.681.131 (Standard Oil Co.-Ohio) Coal feeder stoppage indicator.
2.681.167 (Socony-Vacuum Oil Co.) Method of gas storage, using inorganic oxide gel, release being effected by water.
2.681.271 (Imperial Chemical Industries Ltd.) Production of antioxidants for gasoline (diaminodurene).
2.681.300 (The Texas Co.) Extraction of coal with hydrogenated thianaphthene under pressure.
2.682.154 (Air Reduction Co.) Storage of liquefied gases.
2.682.336 (Phillips Petroleum Co.) Rubber swelling additives aromatics for fuels.
2.682.455-8 (Pittsburgh Consolidation Coal Co.) Gasification of carbonaceous solid fuels.

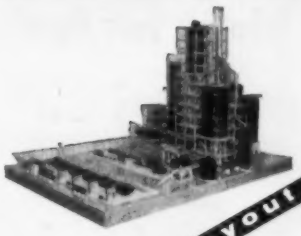
Lubricants

2.680.095 (California Research Corp.) Low temperature grease compositions of polysiloxane and polysiloxane and poloxyalkylene oils.
2.680.096 (California Research Corp.) Process for preparing sulfurized calcium phenates.
2.680.097 (California Research Corp.) Preparation of phenates (Ca and Pb).
2.680.123 (California Research Corp.) Zinc salt of mixed ester thiophosphates.
2.680.716 (Sun Oil Co.) Making sulfonates suitable for use in soluble oil by sulfonating with gaseous SO_3.
2.680.719 (Standard Oil Development Co.) Halocarbon oil greases.
2.681.313 (California Research Corp.) Alkyl orthosilicate and alkoxy-siloxane base grease compositions.
2.681.314 (Shell Development Co.) Process for an inorganic colloid-thickened grease.
2.681.316 (California Research Corp.) Oil compositions stabilized against oxidative deterioration by tetramethyl thiouramdisulfide, etc.
2.681.315 (Standard Oil Development Co.) Lube oil containing Ca petroleum sulfonate, alkyl phenoxypolyethoxyethanol, and alkaline earth metal alkyl phenol sulfide.
2.681.890 (Standard Oil Co.-Ohio) Soluble oil containing reaction products of oxidized oil and PCl_3.
2.681.905 (Socony-Vacuum Oil Co., Inc.) Synthetic lubricants from high V.I. polymers.
2.682.506 (National Research Council, Ottawa) Cellulose base lubricating grease.
2.682.507 (General Electric Co.) Silicone oils having low viscosity-temperature coefficients.
2.682.508 (Monsanto Chemical Co.) Mineral oil compositions of suppressed foaming tendency, containing phosphorus ester and amide.
2.682.523 (Shell Development Co.) Emulsified metal working lubricant containing halogenated wax.

Specialties

2.680.058 (Texaco Development Corp.) Preservation of petroleum in storage over alkaline water layer having toxic boron-containing anion.
2.680.094 (Standard Oil Development Co.) Rust preventive oil composition containing petroleum sulfonate and esters of ethylene bis-imino diacetic acid.
2.680.718 (Standard Oil Development Co.) Rust inhibiting composition containing fatty acid ester of 4-6 OH compound, sulfurized.
2.681.891 (The Texas Co.) Hydraulic transmission fluid containing methacrylate polymers, silicone.
2.682.448 (Phillips Petroleum Co.-Del.) Process for treating high pH pelleted furnace carbon black.
2.682.473 (Universal Oil Products Co.) Stabilization of organic compounds with dihydroxy-dihydro-naphtho-(12-b)-furan.

Industrial Models Inc.



Refinery Layout

Scale models help you see through construction and design problems even before the blueprint stage. Piping drawings can be made directly from the model . . . offer great time and cost reduction in design and layout. Personnel are trained before plant begins operation, eliminating costly start-up delays. Save up to 30 times the cost of the model through better, safer design with lower operating and maintenance cost.

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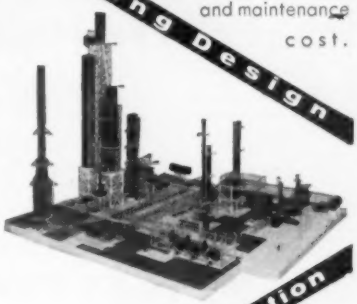

Field Construction

Industrial Models, Inc. is an organization of experienced engineers and craftsmen . . . specialists in scale model construction of plants, laboratories and products. Industrial Models' three completely equipped shops and staff of field engineers are at your service. Write for detailed brochure.

Operator Training

Industrial Models, Inc.

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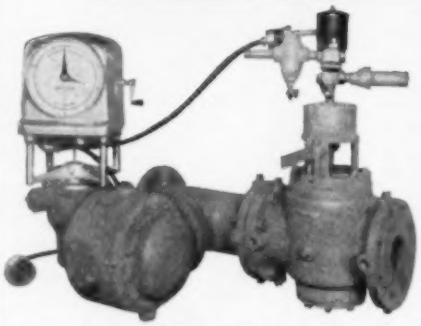
(To obtain more data on advertised products see page 1260)

Whether your liquid measuring problem involves

GALLONS —or BARRELS —or TANK CARS

THE *Fluidometer* SYSTEM

WILL GIVE YOU ACCURATE—AND COMPLETELY AUTOMATIC—BATCHING



If you have a liquid batching problem involving either light or heavy liquids, it will pay you to investigate the Fluidometer System. This completely automatic system, with its exclusive automatic reset, gives accurate, dependable batching and is adaptable to practically any liquid measuring problem, whether it involves gallons, barrels, or tank car lots. Available in either jacketed or unjacketed construction. Write for Bulletin Fl-49.

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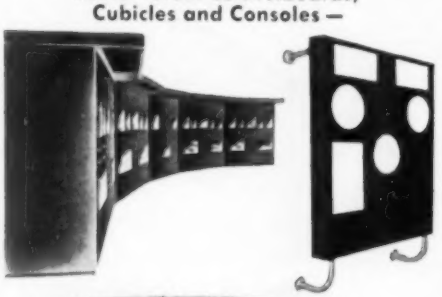
Custom Steel Controlboards, Cubicles and Consoles —



FALSTROM Panels are popular in chemical, refinery, and power plants nationwide. Standard designs, by **FALSTROM**, are the economical solution to all but the most unusual instrument mounting requirements. Where special problems indicate custom designing, **FALSTROM** engineers can design and build complete structures to meet your installation timetables. Call or write for information!

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FALSTROM COMPANY

59 FALSTROM COURT PASSAIC, NEW JERSEY

Patents

2,682,489 (George Hugo von Fuchs) Rust-preventing compositions and process, using succinic ester.

Miscellaneous

2,679,752 (Socony-Vacuum Oil Co.) Method for measuring corrosivity of fluids.
2,680,410 (Standard Oil Co.-Indiana) Self-lubricated rotating seal for centrifugal pumps.
2,681,165 (Standard Oil Co.-Ohio) Explosive hatch.
2,681,312 (Standard Oil Development Co.) Aqueous suspensions of finely divided solid sulfonated phenol-formaldehyde condensation products.

EQUIPMENT

Processing, general

2,680,676 (Phillips Petroleum Co.) Gas reaction chamber.
2,680,706 (Phillips Petroleum Co.) Device and method for preventing carbon laydown during hydrocarbon conversion.
2,681,219 (Koch Engr. Co.) Gas-liquid contact apparatus.
2,681,269 (Socony-Vacuum Oil Co.) Contacting apparatus.
2,681,311 (Petrolite Corp.) Electric treater.
2,681,799 (Joseph van Ackeren) Radial spray type gas and liquid scrubber.
2,682,313 (Research Corp.) Alternating current ion-filter for electrical precipitators.
2,682,314 (Research Corp.) Wet bottom precipitators.
2,682,394 (Shell Development Co.) Spray grid tray column with fluid distribution or drawoff tray.
2,682,395 (Shell Development Co.) Divided down comer for trays of fractionating columns.
2,682,450 (United Carbon Co., Inc.-Md.) Apparatus for producing carbon black.
2,682,497 (Phillips Petroleum Co.) Pebble heater and method of converting hydrocarbons.

Instruments

2,679,746 (Phillips Petroleum Co.) Detonation analyzer.
2,679,750 (Bristol Co.) Apparatus for measuring viscosity and other fluid properties.
2,679,759 (Emil Greiner Co.) Absolute and differential manometer.
2,680,169 (Ralph James Capuano) Liquid level indicator switch.
2,680,371 (Illinois Testing Labs) Dew point measuring device.
2,680,376 (Milton Shaw and Charles Strang, Jr.) Differential pressure-measuring device with ring dynamometer.
2,680,989 (Perkin-Elmer Corp.) Recording spectrometer.
2,681,415 (Max D. Liston) Detectors for gas analyzers.
2,681,575 (Simplex Valve & Meter Co.) Differential pressure-responsive apparatus.
2,682,026 (Gilbert and Barker Mfg. Co.) Electronic level-sensitive apparatus.
2,682,264 (Gilbert J. Garrett) Crude oil sample heating unit.
2,682,277 (Standard Oil Development Co.) Apparatus for obtaining fluid samples and quenching same.
2,682,613 (Specialties Development Corp.) Unit for detecting suspended matter in fluid.

Pumps & Compressors

2,679,807 (De Florez Co.) Pumping device for use with flexible tubing.
2,680,352 (Arthur D. Little, Inc.) Apparatus and method for pumping liquefied gaseous fluids.
2,680,412 (John E. Entwistle) Variable volume variable pressure pump.
2,681,011 (Eugene Frederic Porte) Pump, compressor apparatus.
2,681,152 (Frederick Stindt) Unloader for centrifugal machines.

Valves & Fittings

2,680,449 (Commonwealth Engr. Co.) Lubricated plug valve.
2,680,450 (Sun Oil Co.) A relief valve for controlling gases from storage vessels.
2,681,787 (Crane Co.) Seating mechanism for rotatable plug valves.
2,682,174 (Joseph Heinen) Plug-type valve with vertical adjustment of plugs.

Miscellaneous

2,680,410 (Standard Oil Co.-Ind.) Self-lubricated rotating seal for centrifugal pumps.
2,680,603 (Foster Wheeler Corp.) Cooling tower.
2,680,675 (Phillips Petroleum Co.) Fluid-solid contacting tower.
2,681,833 (Sun Oil Co.) Conduit for elevating contact material.
2,682,181 (Babcock & Wilcox) Tube-cutting apparatus.
2,682,422 (C. T. Stewart) Shaft seal.

PROCESS EQUIPMENT NEWS

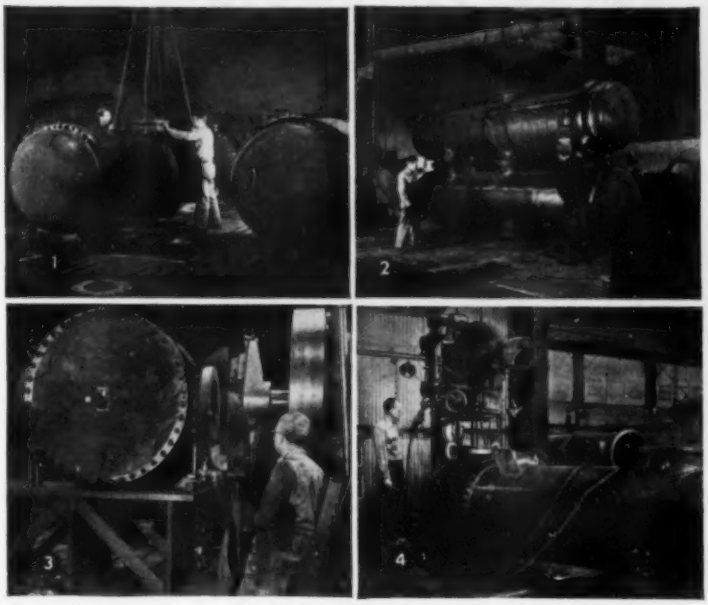
PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY AUGUST-SEPTEMBER 1954

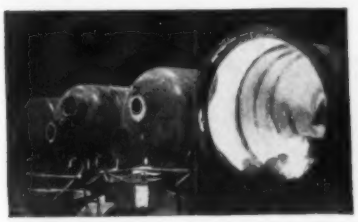
Five Giant Reactors For High Octane Gasoline Plant

In this impressive line-up in Kellogg's Jersey City, N. J., shops (below) are shown four of five identical pressure vessels currently being fabricated for a large Midwestern refiner of petroleum.

When completed, these giants will function as the reactors for a fixed bed catalytic reforming unit —a process that reforms low grade naphthas into high octane gasoline through the use of a platinum catalyst and high temperatures and pressures.

Each of the reactors is 9 feet in internal diameter by 10 feet





3 inches in length. To withstand internal operating conditions of more than 1000°F. and nearly 400 pounds pressure, they are constructed of carbon moly steel, 1-7/16 inches in thickness. When completed, each vessel will tip the scales at 39,000 pounds.

For further information, details of methods, etc. contact
FABRICATED PRODUCTS DIVISION
THE
M. W. KELLOGG
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In Canada—Toronto and Edmonton
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KELLOGG
PULLMAN

Extra Care in Stacking Exchangers Pays Off in Trouble-Free Operation

When an exchanger consists of two or more sections, with shell and tube fluids flowing in series, it is frequently possible to save space, piping, and supporting steel by stacking the units nozzle-to-nozzle. Kellogg, in the course of its 30 years experience in manufacturing exchanger equipment, has developed a number of special techniques for stacking units whenever this arrangement is called for which assure precise alignment of nozzles, easy assembly, and trouble-free operation.

The photographs above show a sequence in just one of the precautionary operations Kellogg uses to assure proper alignment of nozzles in two vertically stacked units. Normal manufacturing and assembly tolerances for nozzle locations, height of nozzles, and angular alignment have of course been taken into consideration in these sections.

At the start of the operation, both units have been inspected and tested hydraulically. With the shell and channel nozzles of one section left unmachined and undrilled, the two units are stacked in the shop (Photos 1 and 2). In this position, the top unit is leveled, supports are shimmed as required, and the nozzles are laid out for facing and drilling to match the nozzles of the lower one which were faced and drilled prior to welding into the unit.

After determining the alignment, machining requirements, and placement of flange holes on the unfinished section, it is taken down and set up in a boring mill (Photo 3) where the nozzle flanges are faced. In the final operation (Photo 4), flanges are drilled according to the layout determined while the units were stacked.

By following this careful procedure in the shop, Kellogg can assure perfect matching of the units when they reach the field. Final assembly is thus made easier, and chances of leaks, once the stacked exchangers are in operation, are reduced to a minimum.

WHAT ABOUT CONTROL OF

FLASHING LIQUIDS?

THE ANSWER IS
THE *EXCLUSIVE*

H---D

FLASH-FLO PLUG*

Another Famous Hammel-Dahl First

ELIMINATES...

- DESTRUCTIVE VIBRATION
- TRIM DETERIORATION
- HIGH NOISE LEVEL

Interchangeable with standard trim in ∓% or linear characteristics

Complete Information in Bulletin 101-B

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MANUFACTURING PLANTS IN WARWICK, R. I., U. S. A., CANADA, ENGLAND, FRANCE AND HOLLAND

CANADIAN MANUFACTURING AFFILIATE—GUELPH ENGINEERING CO., GUELPH, ONT.

Visit our Booth 410-412, First International Instrument Exhibit—Philadelphia, September 13 thru 24.

ALVIN B. WALDRON has been re-elected to the Lakeview, Texas, town council

HERBERT C. AICHELE, councilman of Oaklyn, N.J., speaks at a town ceremony

HUGH McVICKER is sworn in as burgess of Folcroft, Pa., as his family watches. He also has served as a justice of the peace for 13 years

Refinery Men Participate in Civic Activities

THE Atlantic Refining Co. is a firm whose employees often can be found taking an active or leading part in community life. They work in the usual civic organizations—the church, veterans' clubs, service clubs, etc. Some of them have important posts in the local government or county and state-wide groups.

Of the employees at the company's refineries, for instance, there are four councilmen, a mayor and a town burgess. As if any one wasn't enough to do in addition to their regular jobs, two of these men hold a second post in the community. **F. E. Sinex,** who works at the Philadelphia refinery in the personnel department and as an associate editor of the company magazine, is not only a member of the Sharon Hill, Pa., town council, but also belongs to the Delaware county planning commission, an important civic body.

Besides his job as burgess of Folcroft, Pa., **Hugh McVicker,** has been a justice of the peace for 13 years. His job is as a personnel assistant at the Philadelphia refinery. Mr. Vicker also acts as secretary of the Delaware County Magistrates' Association and director of the Pennsylvania Ass'n.

The mayor is **Ray Lott,** a super-

RAY LOTT is in his second term as mayor of Barrington, N.J.

F. E. SINEX is on the Sharon Hill (Pa.) council and a county planning group

J. B. HARGUS is a second-term city councilman in Groves, Texas

MARLEY SINGLE-FLOWS

put the Weather Vane to work

Prevailing winds [illegible]emy of one induced draft cooling tow[illegible] MARLEY SINGLE-FLOW. Instead, the wind is put to work by placing the one louvered face of the Single-Flow to utilize this source of natural cooling potential. Results: a high degree of atmospheric cooling that gives performance a substantial lift . . . a real power saving in day-to-day operation . . . a comfortable margin of safety in the event of power failure.

These are not theoretical advantages; they are facts obtained from tests in many plants in the Southwest and other areas. Winds of 10 to 15 mph will operate a high Single-Flow at near half design load with fans off, and near design load with fans at half speed. This means positive operating economy that every plant is seeking.

Another advantage of the Single-Flow is that with its one open side properly positioned, prevailing winds can not cause recirculation of warm, moist air. That is why Marley places no 7-mile-per-hour test restriction on the Single-Flow, but permits you to test your tower realistically under existing local conditions.

For complete information on the many advantages of this unique tower offered only by Marley, write today for Marley's latest catalog on cross-flow cooling towers. Ask for Bulletin CF-54.

MARLEY

Founder-member of the Cooling Tower Institute

The Marley Company

Kansas City, Missouri

visor in the water division at the Philadelphia plant. He was recently re-elected by the people of Barrington, N. J.

Down in Texas at the Atreco refinery, near Port Arthur, **Alvin B. Waldron,** a boilermaker, is serving his second term on the town council of Lakeview. In nearby Groves another Atreco employee, **J. B. Hargus,** a pipefitter for Atlantic, shares in the decisions of the town council, where he is now in his second term.

Herbert C. Aichele, senior industrial engineer at the Point Breeze, N. J., refinery, is a second-term councilman in the town of Oaklyn, N. J.

Harold G. Mangelsdorf, general manager of manufacturing of Esso Standard Oil Co., has been elected a director of the company. He joined Esso in 1934 at the Baton Rouge, La., refinery, where he later became assistant general manager. He transferred to the Bayway refinery at Linden, N. J., as general superintendent in 1950 and was named general manager of east coast manufacturing in 1952. His appointment to general manager occurred in November, 1953.

Mr. Mangelsdorf

Clarence Herbert Thayer, vice-president in charge of manufacturing for the Sun Oil Co., was awarded the honorary degree of Doctor of Engineering by the Drexel Institute of Technology, Philadelphia.

In part, the citation read, "By virtue of his creative imagination, his great engineering talents, and his high personal integrity he has contributed mightily to the growth of the oil industry in the United States and Canada, more particularly to improvements in the technology of refining."

Donald B. Benedict is the new works manager of the Carbide and Carbon Chemicals Co., a subsidiary of Union Carbide and Carbon Corp. He replaces **H. D. Kinsey,** who has become vice-president in charge of production operations.

Mr. Benedict is a University of Michigan graduate, where he received a B.S. degree in 1932 and a M.S. in chemical engineering in 1933. In the same year he began his employment with Carbide and Carbon Chemicals Co. as a technical assistant at the company's South Charleston, W. Va., plant. He progressed through a number of positions at this plant, becoming assistant superintendent of chemicals and resins in 1940 and general superintendent of the plant in 1952. He was transferred to the New York office in 1953, when he became assistant works manager.

R. G. (Dick) Arner, manager of Sinclair Refining Co.'s East Chicago, Ind., refinery, has been moved up to the newly created position of assistant to the vice-president in charge of manufacturing. His job in this post is to coordinate activities of the refinery department with oil purchasing, pipe line transportation, and research and marketing operations, particularly with respect to refineries at East Chicago, Wood River, Ill., and Sinclair, Wyo.

Mr. Arner

Mr. Arner has made his headquarters in the Sinclair Oil Building, which is nearing completion in Chicago.

Lee N. Haugen, formerly a vice-president of Cities Service Oil Co. (Del.), has been elected vice-president and general manager of the Cit-Con Oil Corp., Lake Charles, La., an enterprise jointly owned by Cities Service and Continental Oil Co. The Cit-Con firm is a manufacturer of lubricating oils. The plant adjoins the Cities Service refinery at Lake Charles.

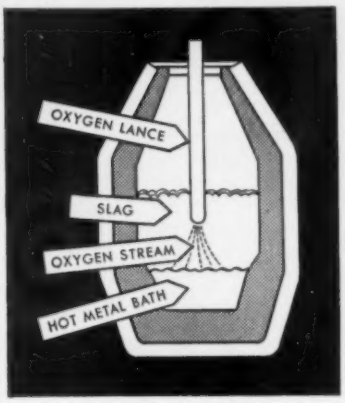
Mr. Haugen has been replaced by **William T. Cravens,** who was moved to vice-president and general manager of Cities Service from the post of general superintendent of the company's refining division.

The former president of Cit-Con Oil Corp., **F. M. Simpson,** has become vice-president and general manager of Petroleum Chemicals, Inc., another jointly owned subsidiary of Cities Service and Continental Oil. He is establishing New York City headquarters for the firm, which was recently formed to engage in petrochemical research and manufacturing.

David W. Harris, president of Universal Oil Products Co., Chicago, received the Georgia Tech alumni distinguished service award for 1954. Mr. Harris was a 1912 graduate of the school and was given the award as a "leading petroleum executive, industrialist, son of a Georgia governor and

what's NEW in Engineering

To cut refining costs of steel, Kaiser Engineers has acquired the exclusive U. S. rights for the Brassert Oxygen Converter Process of producing high quality steel. Recognized as an advanced development



in steelmaking, the oxygen process promises a definite saving in refining costs of at least $3.00 per ton. Investment cost is also lower, as one 35-ton oxygen converter will produce as much as three 175-ton open hearth furnaces at half the estimated capital investment. Write us for a brochure describing the process in detail.

The largest construction contract in Australia's history has been awarded to the Kaiser-Walsh-Perini-Raymond group of American contractors. With Kaiser Engineers as the project's sponsor, the group will construct a dam and mammoth 14-mile water tunnel through the Snowy Mountains of Southeast Australia.

Asme Handbook Metals Properties. This is Volume I of a four volume handbook sponsored by The Metals Engineering Handbook Board of the American Society of Mechanical Engineers. Published by McGraw-Hill, METAL PROPERTIES tabulates strength, hardness and the other properties of over 500 metals.

Whatever your immediate research, design or engineering problems, however unusual they may be, an early consultation with Kaiser Engineers is an important step toward their quick, profitable solution. Call or write Kaiser Engineers Division of Henry J. Kaiser Company, Kaiser Building, Oakland 12, California.

(To obtain more data on advertised products see page 1260)

a founder of Georgia Tech, and distinguished native Georgian."

Laurance A. Gleason, formerly technical assistant to the general superintendent at the Bayonne, N. J., refinery of Tide Water Associated Oil Co., has been promoted to the post of assistant to the vice-president in charge of manufacturing in the company's eastern division.

Mr. Gleason

Mr. Gleason joined Tide Water Associated in 1947 as a junior engineer in the process control department at the Bayonne refinery. He became technical assistant in the department in 1951 and a month later technical assistant to the general superintendent.

R. K. Walters, formerly construction superintendent at the Norco, La., plant currently under construction by Shell Chemical Corp., has been transferred to New York City as assistant manager of the company's manufacturing engineering department.

Mr. Walters received a B.S. degree in architectural engineering from the University of Texas and an M.S. degree in the social sciences from the University of Houston. He joined Shell as a draftsman in Houston in 1936 and became chief engineer there in 1946. He assumed his job on the Norco project in 1953.

C. P. Boutte, who was the chief engineer at Shell Chemical's ammonia plant in Ventura, Calif., has been made the chief engineer of the Norco plant. Mr. Boutte received a degree in petroleum engineering from Louisiana State University. He was employed by Shell at Norco in 1929, and in 1937 was transferred to Houston as plant inspector. In 1946, on his return from military service, he became chief engineering inspector at Houston. He was appointed chief engineer at Ventura in 1952.

Mr. Boutte's replacement at Ventura is **G. A. Daniels,** formerly senior engineer there. Mr. Daniels holds a B.S. degree in electrical, mechanical and civil engineering from the University of California at Los Angeles. He joined Shell as an engineer at Pittsburg, Calif., in 1939. On his return from military service, in 1945, he was appointed a senior engineer at San Francisco and later moved to New York in the same capacity. He became project engineer in charge of construction of the Ventura ammonia plant, remaining at the compieted plant as senior engineer.

William F. Kramer, formerly general inspector at Pure Oil Co.'s Toledo, Ohio, refinery, has been promoted to chief inspector and assistant general manager of the company's refinery technical department, with headquarters in Chicago, Ill. In his new post he covers the company's entire network of refineries.

Replacing Mr. Kramer as general inspector at the Toledo plant is **Lewis J. Robb,** who was the refinery's assistant general inspector. Mr. Robb has been with Pure Oil since 1946, when he began as a refinery trainee.

D. Vance Fulton has been moved up to fill Mr. Robb's post of assistant general inspector. He joined the company in 1949.

YEL⊖BAK ... *Industrial*

THERMOMETERS

Flat Bore—Mercury Filled—Engraved Stem—with 18-8 stainless steel stems. Chromium-plated case to resist corrosion and dirt. These midget industrial thermometers are recommended for equipment requiring Small Armored thermometers . . . and where large industrial thermometers are inappropriate.

An economical instrument . . . because thermometers may be replaced "on the job" . . . that is—refill can be inserted into Armored Case without difficulty . . . eliminates necessity of sending instrument to factory for thermometer replacement. Assured Accuracy.

REFINERY SUPPLY COMPANY

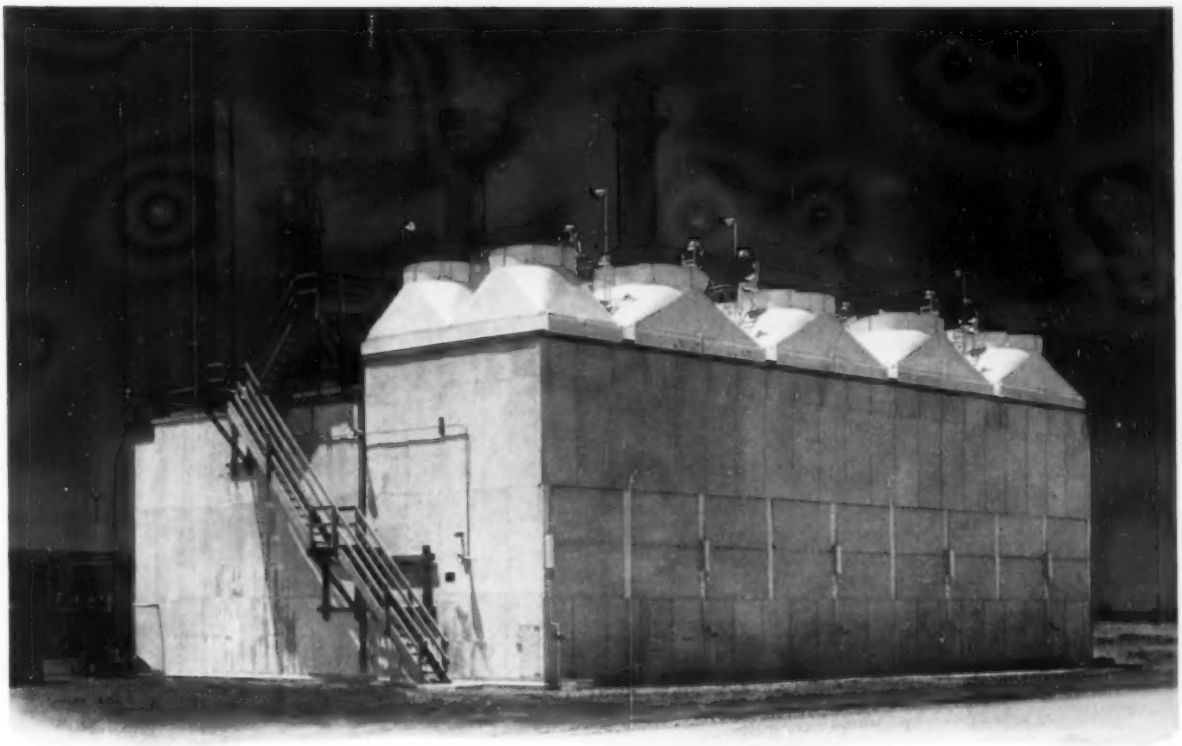
621 EAST FOURTH STREET ● TULSA 3, OKLAHOMA
2215 McKINNEY AVENUE ● HOUSTON 3, TEXAS

cenco

The most complete line of scientific instruments and laboratory supplies in the world.

R.S.G.

CENTRAL SCIENTIFIC COMPANY
1700 IRVING PARK ROAD ● CHICAGO 13, ILLINOIS
CHICAGO NEWARK BOSTON WASHINGTON DETROIT SAN FRANCISCO
SANTA CLARA LOS ANGELES TORONTO MONTREAL VANCOUVER OTTAWA



HUDSON Combin-aire UNITS

In four years of varied services have proven their advantages

COMBIN-AIRE units are in use for over 20 cooling services, operating on the humid Louisiana coast and the dry plains of West Texas and Oklahoma. Each unit has more than met its performance specifications.

The COMBIN-AIRE is a combination of a comparatively small Hudson water cooling tower with Hudson SOLO-AIRE hot fluid to air exchangers housed in one integral structure. In hot weather air to be used for cooling is reduced to near wet bulb temperature by contact with water near the bottom of the cooling tower. The cooled air is then used for cooling in the SOLO-AIRE units.

In cold weather the use of water is unnecessary. In the above photograph of the integrated structure the SOLO-AIRE units are in the upper foreground and the cooling tower portion is partially obscured in the background. In cold weather the shutters in the foreground may be opened to admit air directly to the SOLO-AIRE units.

Any one or more of the following proven advantages may dictate the use of COMBIN-AIRE for your next cooling problem.

1. **MINIMUM WATER REQUIRED.** No water used in cold weather. No loss from spray or carryover.
2. **NO WATER TREATMENT.** Hard water, sea water or water containing organic matter may be used.
3. **MINIMUM PIPING.** Absence of carryover or condensation allows installation adjacent to other equipment. Auxiliary shell and tube sub-coolers unnecessary.
4. **CLEAN AIR.** Air reaching Solo-aire units is free of dust, sand and insects.

The COMBIN-AIRE unit is protected by United States patents

HUDSON
ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

HUDSON
Top Performance
COOLING EQUIPMENT

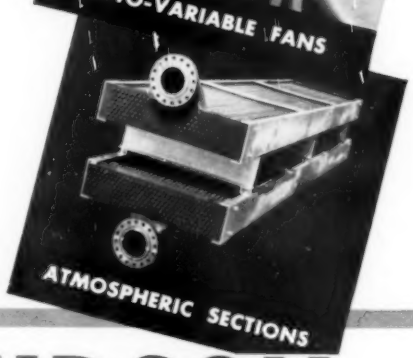
For more than two decades HUDSON personnel have developed equipment for heat recovery and heat dissipation. Present day HUDSON cooling equipment has been evolved through the years by constant improvements in design and fabrication.

COOLING TOWERS

SOLO-AIRE EXCHANGERS

COMBIN-AIRE UNITS

AUTO-VARIABLE FANS


ATMOSPHERIC SECTIONS

COOLING TOWERS

Beauty and utility have been successfully combined in the HUDSON "TP" design. These Top Performance cooling towers embodying new but proven advancements in water cooling design, result in lower installation and operating costs for a given guaranteed performance.

SOLO-AIRE EXCHANGERS

HUDSON Solo-aire exchangers for jacket water cooling, gas cooling, steam condensing and hydrocarbon vapor condensing have found wide use, particularly where suitable cooling water is impossible or expensive to obtain. Even where adequate quality and quantity of water is available there are conditions under which these units have marked advantages over alternative cooling methods. Designs are available for pressures up to 5,000 pounds per square inch.

COMBIN-AIRE UNITS

By combining in one structure Solo-aire units with a cooling tower, HUDSON originated the Combin-aire unit. In hot weather, air before use in the Solo-aire units, is contacted with water to reduce both air and water temperature. In cold weather, water use is unnecessary. This device makes possible the use of air for low temperature cooling, allows use of untreated water, minimizes water consumption, and results in capital and operating savings.

AUTO-VARIABLE PITCH FANS

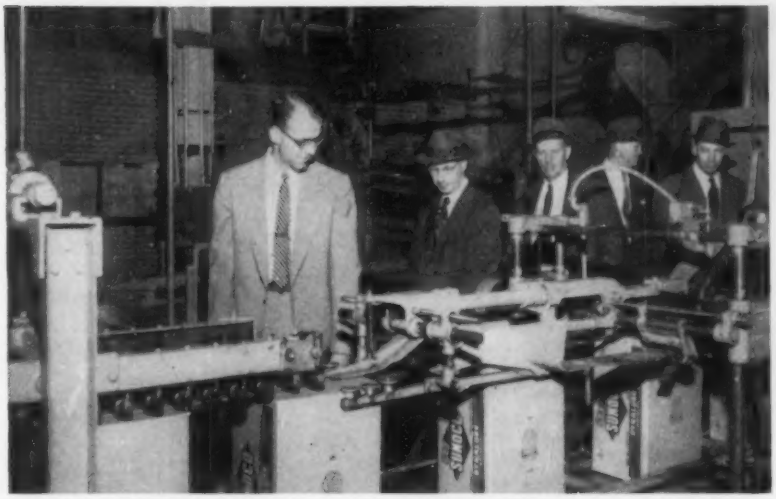
The latest in a long list of Hudson innovations. The auto-variable pitch fan controls cooler outlet temperature through automatic change in fan blade pitch, which in turn changes air volume across cooler tubes. Outlet temperature is closely controlled, and in a typical case horsepower consumption over the year is reduced seventy percent as compared with fixed pitch fan operation.

ATMOSPHERIC SECTIONS

These units are for use where water serves as cooling medium. They may be mounted vertically or horizontally, under cooling tower or submerged in water.

UNDIVIDED RESPONSIBILITY—***Complete integration of facilities in selection, design and manufacture of cooling towers, water cooled atmospheric sections, and air cooled exchangers results in cooling systems of minimum first cost, minimum operating cost, and in undivided responsibility.***

HUDSON
ENGINEERING CORPORATION
FAIRVIEW STATION • HOUSTON, TEXAS



TO GET AN INSIDE VIEW of how a modern petroleum processing plant looks and operates, 24 representatives of Hercules Powder Co., Wilmington, Del., toured Sun Oil Co.'s refinery at Marcus Hook, Pa., May 28. They were the guests of Sun and PETROLEUM PROCESSING, whose staff arranged the trip. The Hercules personnel included people primarily from the company's Naval Stores Dept. and Experiment station.

After a general description of the plant and what it does, given by Robert A. Matteson, Sun chemical engineer, the group viewed the refinery by bus and inspected specific installations close up, including the aromatics petrochemical manufacture and recovery units, a gas plant, and the lube oil blending and packaging plant. In addition to Mr. Matteson, Sun's technical guides on the tour included Millard Brown and Edward Lindberg. Three PETROLEUM PROCESSING staff members were with the group.

Computer Service Started

Electronic analog computer equipment and a staff of scientists to operate it are available to industry for hire at an analog computer center opened recently near Princeton, N.J., by Electronic Associates, Inc. In addition to the usual function of rapid solution of complex problems in engineering research, design, and distribution, the equipment and staff are capable of dealing with problems in management operations control, dynamic systems analysis, and applications engineering.

To each problem submitted the center assigns scientists, engineers or mathematicians, and when individual situations require specialized aid the firm has access to additional scientists from various research institutions and universities in the area.

Little Buys West Coast Labs

The consulting and research activities of Arthur D. Little, Inc., Cambridge, Mass., have been enlarged on the west coast by the acquisition of laboratories of the Merrill Co., a metallurgy and engineering firm in San Francisco.

The eastern firm has already established an office in San Francisco for technical-economic survey work, including industrial market research, diversification studies and other management services, but the new laboratories, with their staff of technicians, give Arthur D. Little, Inc., facilities necessary for the full line of work of a consulting industrial research and engineering organization. The laboratories of the Merrill Co. are now known as the western laboratories division of Arthur D. Little, Inc. The company plans to develop them along lines of particular interest to west coast industry.

Charles G. Harford has been transferred by the Little firm to San Francisco and made technical director of the new division. Raymond E. Byler, who was associated with the Merrill Co., is the division's business manager.

Canadian Affiliate for Gill

Formation of a Canadian affiliate, Mannix-Gill Ltd., has been announced by J. B. Gill Co. of Long Beach, Calif., and Tulsa, Okla. Like its parent concerns, the new company will specialize in building petroleum transportation and processing installations; facilities for H_2S and CO_2 removal; and sulfur plants, petrochemical plants, steam and diesel power plants, and other heavy industrial facilities.

F. C. Mannix is chairman of the board of Mannix-Gill, and Glenn J. Gill is president and general manager. Other officers are W. G. Palmer, vice-president and assistant manager; P. J. Soukup, vice-president; E. Connelly, treasurer; E. W. Costello, secretary; B. E. Kimberlin, general superintendent, and H. D. Saunders, chief estimator and purchasing agent.

Headquarters are in the Oil Exchange Building, 7th Avenue West, Calgary, Alberta.

Foxboro Opens New Plant

The Foxboro Co.'s expansion program for this year is two-thirds complete with the recent opening of a new plant in Pittsburgh, Pa. The first third of the construction plan was fulfilled in April when the factory at Dallas, Texas, was opened. The final unit, a plant at San Leandro, Calif., is expected to be finished August 15.

The Pittsburgh factory will, when it is in full production, double the company's instrument assembly, service and repair facilities in the area it is intended to serve—Pennsylvania, West Virginia, Kentucky and Ohio. It is located close to the new East and West Parkway and the Greater Pittsburgh airport. The building has been constructed with two levels and is of steel and masonry with a modern brick exterior. The lower level encloses sales headquarters and general offices; the upper has space for the assembly, servicing and stocking of instruments and control valves.

Mr. Cox

Mr. Weinrich

Two Open Consulting Offices

John T. Cox, Jr., and W. Whitney Weinrich have announced their association as consulting chemical engineers and opened offices at 1518 "K" St., Washington. Mr. Cox has been in Washington for some time working in the rubber, chemicals and petrochemicals industries.

Mr. Weinrich has extensive expe-

Better Check ORBIT can prevent losses !

There was a time when Orbit Forged Steel LP-Gas valves were used chiefly in the tough services by plant men — now they are being widely used throughout hydrocarbon plants because they have proven to be the most economical valve to operate over the long run. You can depend upon Orbit Valves for a positive shut-off and a very low maintenance cost.

Engineering and construction companies who design and build plants have often in the past been required to figure dual valving for some installations. This is no longer necessary when Orbit Valves are specified. Take the matter of Orbit LP-Gas Valves up with the engineering company figuring with you on a new plant or an expansion job. They know about Orbit Valves, too.

Orbit Forged Steel LP-Gas Valves are offered in sizes beginning with 1″ through 6″, A.S.A. Class, 150 pound to 2500 pound Series. Maximum rated working temperature 250° Fahrenheit.

BRANCHES

HOUSTON, TEXAS
407 Velasco
(Serving the Gulf Coast)

ODESSA, TEXAS
402 West County Road
(Serving West Texas)

CASPER, WYOMING
247 West First Street
(Serving the Rocky Mountain States and Canada)

There Is ONLY ONE ORBIT VALVE

ORBIT VALVES®

ORBIT VALVE COMPANY

P. O. BOX 699 TULSA, OKLAHOMA

rience in the petroleum industry, having been manager of Catalytic Construction Co.'s process engineering department. In addition, Mr. Weinrich has done work in the design and development of atomic energy processes.

Scientist-Editor Joins Fisher

Dr. George L. Buc, formerly of Tidewater Oil Co. and editor of the journal *Applied Spectroscopy*, has joined the central control staff of Fisher Scientific Co. and become a technical assistant to the company's president. In addition, he will be a member of the new products committee and the development projects committee.

Dr. Buc has been editor of the spectroscopy journal since 1946 and will continue his work with it from the Fisher company's headquarters plant in Pittsburgh.

Prior to joining Tidewater Oil, Dr. Buc did basic research in the Calco laboratories of American Cyanamid for 12 years. He has also taught radio, mathematics and physics at Rutgers University.

Personnel Changes

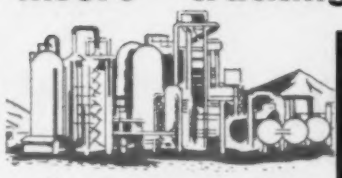
Davison Chemical Co.—John Benedict, sales representative of the petroleum catalyst department, has been transferred to the company's new Houston, Texas, office from Baltimore for promotion of fluid cracking catalysts and other refining products; C. Victor Bolles, field service engineer of the industrial chemicals department, has also been moved to the Houston office from Lake Charles, La., to handle sales of silica gels, fine silicas, specialty catalysts and other products.

Nordberg Mfg. Co.—E. L. Farrell to district manager of the Milwaukee territory, including Wisconsin, Minnesota, Iowa, and northern Illinois; Wm. C. Young to district manager of the Great Lakes territory, which comprises Michigan, Indiana, Ohio, western Pennsylvania, and eastern Kentucky. Both men will maintain headquarters at Milwaukee, Wis.

Worthington Corp.—Fenmore E. Dunn to general manager of the reorganized vertical turbine pump division, with headquarters at the company's Succasunna, N.J., works.

Walter Kidde Constructors, Inc.—E. G. Robbins to general manager of construction, succeeding the late C. W. Knowles.

Insure "cracking good" production



. . . with **AIRETOOL** tube maintenance equipment

Give small as well as large tubes in your plant thorough, periodical cleaning and overhaul with Airetool Tube Maintenance Equipment . . . you can safely carry on peak production for longer periods without danger of breakdown during high-priority runs.

CLEAN

. . . small-diameter condenser and heat exchanger tubes quickly and efficiently . . . even those completely choked with hardest deposits, with Airetool Condenser Cleaners. Geared or direct drive . . . air or electric motors . . . flushing device keeps drill head cool at all times. A full variety of drill, reamer and brush cleaner heads are available.

EXPAND

. . . tube joints in condensers and heat exchangers in less time . . . to a uniform tightness with maximum bonding between tube and tube sheet. Precision-made, ball bearing Airetool Tube Expanders roll tubes to 2½" I.D.; the Airetool Tube Expansion Control System saves time . . . eliminates "over-rolling."

Write for complete information on Airetool Tube Cleaning and Expanding Equipment

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

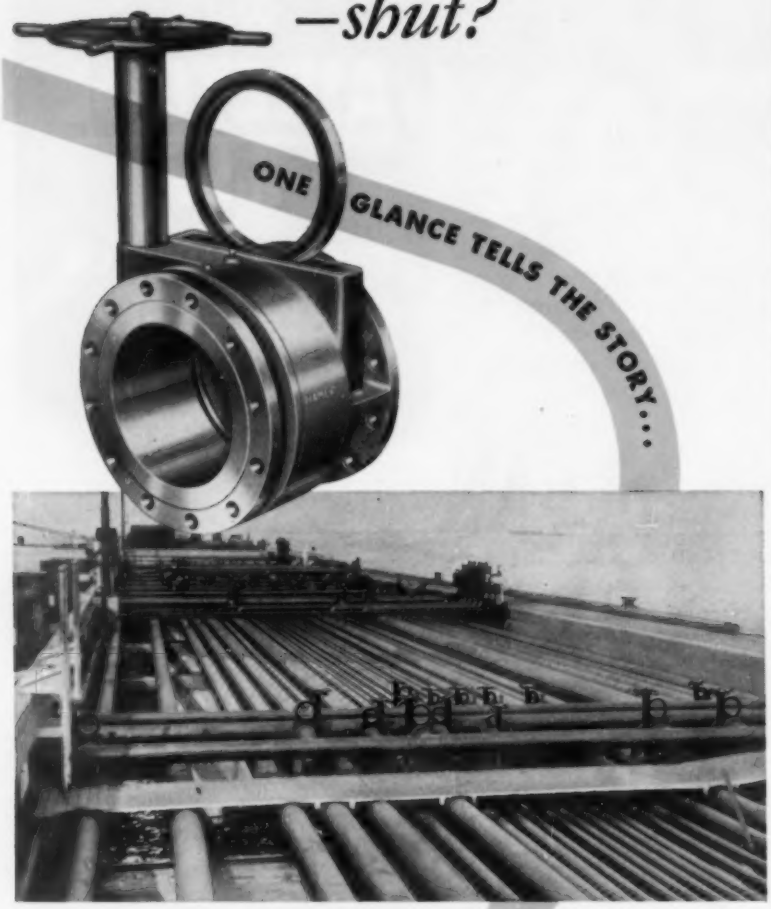
BRANCH OFFICES:
New York, Philadelphia, Houston, Chicago, Tulsa, Baton Rouge.

Representatives in principal cities in U.S.A., Canada, Mexico, South America, England.

(To obtain more data on advertised products see page 1260)

Lines open?

—shut?



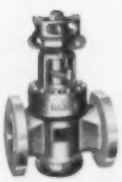
HAMER *Visible Shut-off*

LINE BLIND VALVES

Don't guess—With the Hamer Line Blind Valves you know instantly at a glance which lines are open and which are shut. If the open end of the spectacle plate is up, the line has a **permanent, positive shut-off**...blank end up indicates a round, full open line. And Hamer Line Blind Spectacle Plates are easily visible from a distance... no need for individual valve checking. An enclosed plate slot on the Hamer Valve eliminates product waste while spectacle plate is being reversed—stops mess, reduces fire hazard.

HAMER *Plug Valves*

Standard dimensions... easy to substitute in existing installations. There's a HAMER *non-stick* Plug Valve for any requirement.



Send for free catalog.

HAMER VALVES, INC.

2919 Gardenia Avenue
Long Beach 6, California
Representatives throughout to United States

Suppliers

Calumet & Hecla—Rod Davies and Stuart Maise to sales representatives, with headquarters in Detroit, for the Wolverine Tube Division.

Conoflow Corp.—Warren H. Brand to director of engineering and research, with headquarters in the company's executive offices in Philadelphia. Mr. Brand was formerly with the Atomic Energy Commission at the Oak Ridge National Laboratory, Oak Ridge, Tenn.

Cooper-Bessemer Corp.—Robert F. Lay, from chief engineer of the product division to assistant general sales manager; Eugene L. Miller, from supervisor of application engineering to assistant general manager.

Panellit, Inc.—Walter P. Hooper to administrative vice-president of Panellit, Inc., as well as its two divisions, Panalarm and Panascan.

Babcock & Wilcox Co.—N. J. Connor to manager of the New York district office, replacing H. E. Martin, who has resigned to become president and a director of Metal & Thermit Corp.

Commercial Solvents Corp.—James A. Farley to field sales manager of the industrial chemicals sales department, with headquarters in New York; Geoffrey H. Snider to manager of the Boston district office, replacing Mr. Farley; J. H. Brinton Marple, formerly with the New York sales staff, replaces Mr. Snider as manager of the Louisville, Ky., district office; Arthur F. Williams leaves the Boston office to join the sales office in New York.

Graver Tank & Mfg. Co.—Harold R. Fosnot to sales manager of the Graver Water Conditioning Co. division.

U.S. Steel—E. W. Johnson to manager of process pump sales for Oil Well Supply Division, with headquarters in Dallas, Texas.

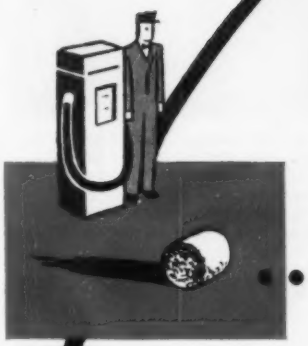
Midwest Piping Co.—Guy L. Morrill to vice-president, continuing as manager of the west coast plant in Los Angeles.

Enjay Co., Inc.—Brian Casey to technical sales representative in the Paramin additives sales division.

Stone & Webster Engineering Corp.—E. J. Ford to construction manager, with headquarters in Boston.

(*To obtain more data on advertised products see page 1260*)

with ATLANTIC



...it's the catalyst that counts!

The Davison Chemical Corporation has teamed with The Atlantic Refining Company in the development of a catalyst for reforming straight run and cracked gasolines to a product of higher octane level. Among the important tasks delegated to Davison was the translation of this catalyst from laboratory to commercial production and at the same time impart optimum selectivity, stability, ruggedness and regenerability.

Today, Davison is producing Atlantic Platinum Reforming Catalyst on a commercial scale and shipments are being made at an increasing rate to licensees of the Atlantic Catforming Process. Davison has an outstanding record of this type of development in many fields of commercial catalyst production. If you have a catalyst problem, see your Davison Field Service Engineer or write.

Progress Through Chemistry

DAVISON CHEMICAL COMPANY

Division of W. R. Grace & Co.

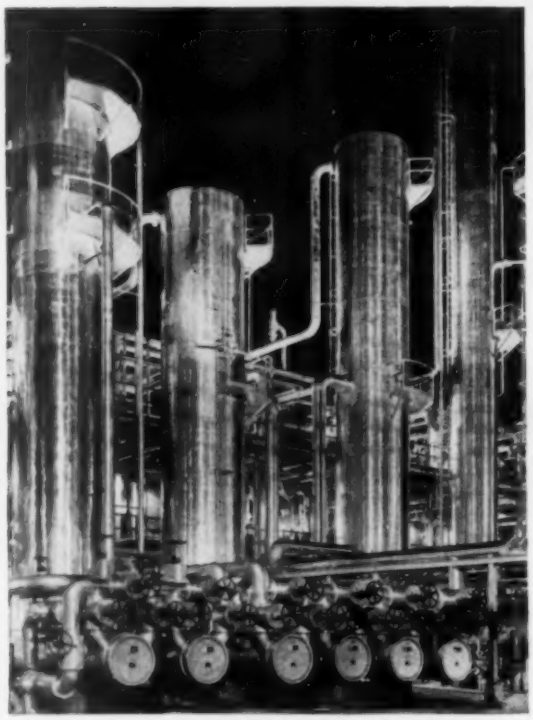
BALTIMORE 3, MARYLAND

PRODUCERS OF: CATALYSTS, INORGANIC ACIDS, SUPERPHOSPHATES, TRIPLE SUPERPHOSPHATE, PHOSPHATE ROCK, SILICA GELS AND SILICOFLUORIDES. SOLE PRODUCERS OF DAVCO GRANULATED FERTILIZERS

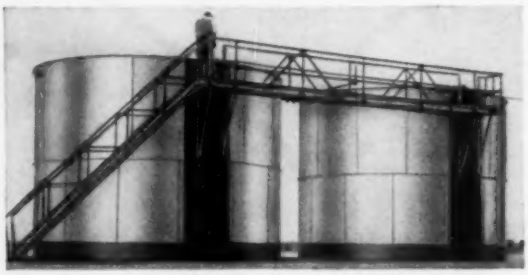
 (To obtain more data on advertised products see page 1260)

SEE HOW ALUMINUM CAN CUT YOUR COSTS!

These are a few of the many products that save money by lowering maintenance and increasing efficiency in chemical and petroleum processing plants. Reynolds does not make these products . . . but Reynolds Aluminum is used by the manufacturers who do. We'll furnish their names on request.

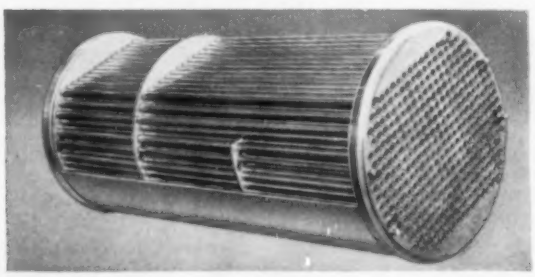


Insulation and vessel jacketing: Aluminum sheet in single layers over bulk insulation offers long life and maintenance free protection. Applied in separate layers, aluminum provides lightweight, moisture resistant, heavy duty insulation. Aluminum insulated and protected plants look better longer with less upkeep.



Aluminum Tanks and Tank Decks: You can now eliminate maintenance and costly corrosion damage with aluminum tanks and containers for nitrogen solutions, oils, acids, hydrogen peroxide and many other corrosive fluids. End expensive replacement of decks and supports by installing aluminum roofs and upper sections in sour crude storage.

Aluminum Gratings, Treads and Handrails: Aluminum installations like this grating will never require painting, are not damaged by sulfide atmospheres, and as a result, give longer life. Lightweight strength, installation economy and pleasing appearance make aluminum the preferable material.



Aluminum Heat Exchanger Tubing: Costs less and lasts longer. Aluminum tubing is widely used for H_2S, CO_2, NH_3, hydrogen peroxide, oils, acids and many wax products. High heat transfer, non-fouling surfaces and reduced maintenance costs are other advantages offered by aluminum.

PUT ALUMINUM'S ADVANTAGES TO WORK FOR YOU

- Light weight with great strength
- Natural resistance to rust and corrosive atmospheres
- Attractive appearance
- Ease of fabrication
- Non-sparking

For more information call the Reynolds office listed under "Aluminum" in your classified telephone directory. Or write to Reynolds Metals Company, 2596 South Third Street, Louisville 1, Kentucky.

See "Mister Peepers", starring Wally Cox, Sundays on NBC-TV.

REYNOLDS ALUMINUM

MODERN DESIGN HAS ALUMINUM IN MIND

Suppliers

Foxboro Co.—William A. Rock to Shultz y Cia, S.A., of Mexico City, the Foxboro Co.'s representative in Mexico. Mr. Rock makes his headquarters in Monterrey.

Flexonics Corp.—Harvey Wilson to field sales engineer; Walter Keipper to offices sales supervisor of the expansion joints division, replacing Mr. Wilson.

Orr & Sembower, Inc.—Edgar A. Burt to chief engineer, from Westinghouse Electric Corp.

Hooker Electrochemical Co.—Richard F. Graham to sales representative at the Wilmington, Calif., office.

A. O. Smith Corp.—Robert O. Dehlendorf to assistant general sales manager of the electric motor division.

Davison Chemical Co.—William E. McGuirk, Jr., to executive vice-president.

Celanese Corp. of America—Verne Nazarek to New York as assistant to M. S. Kirpalanas, export manager of the chemical division. Before joining Celanese, Mr. Nazarek was editorial production manager of PETROLEUM PROCESSING.

Bell & Gossett Co.—A. F. Woods to sales manager for the Marlow pumps division, replacing "Andy" Rubin, who has opened his own business as a distributor in Fort Pierce, Fla.

Fluor Corp., Ltd.—John W. Hubenthal to district sales manager of Chicago district, succeeding Robert E. Nagel, who will continue at the Chicago office as a sales consultant; Harry B. Christman to manager of construction for the subsidiary, Fluor Corp of Canada, Ltd.

Lukens Steel Co.—Harry R. Meyer to manager of sales for the By-Products and Lukenweld Divisions.

Bonney Forge & Tools Works—Spencer H. Mieras to general manager; Kenneth Foust to secretary-treasurer.

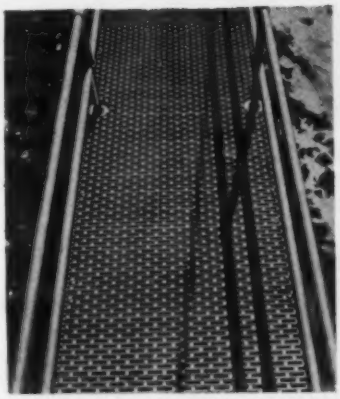
Calumet & Hecla, Wolverine Tube Div.—R. E. Engel to sales representative in the Oklahoma-Kansas area.

Harbison-Walker Refractories Co.—C. A. Brashares to general sales manager.

WACO ALUMINUM GRATING and TREADS

Cut your costs!

By reducing maintenance.
By increasing service life.



WACO ALUMINUM GRATING
for walkways, platforms and other exterior applications eliminates costly maintenance and periodic repair and replacement.

SPECIFY WACO FOR:

1. *Lightweight strength*
2. *Corrosion resistance*
3. *Non-sparking safety*
4. *Easy installation*
5. *Low maintenance*

CALL ON WACO ENGINEERS' DESIGN EXPERIENCE IN APPLYING ALUMINUM IN PLANT CONSTRUCTION.

Send for DATA BULLETIN #10-P

WASHINGTON ALUMINUM CO.
BALTIMORE, MARYLAND

EXCEL-SO WATER SEPARATORS
for refinery applications

Provides continuous coalescing of water in sulphuric acid alkylation, caustic treating, polymerization, and other entrainment problems.

Write for Process Manual R-101-53

WARNER LEWIS COMPANY
BOX 3096 • TULSA, OKLAHOMA

Just Out

A business guide for the chemical industries

Prepared by a staff of specialists under the editorship of John H. Perry, also Editor, *Chemical Engineers' Handbook*.

Now you can have expert guidance on all fundamentals and operations of effective business management *in terms of your field* — everything made doubly useful by being aimed especially at chemical industry problems. In 20 big sections, 125 specialists show you every essential aspect of market research, finance, purchasing, traffic, insurance, and a host of other business operations—a wealth of dependable facts to help you handle managerial problems and responsibilities better in this field.

CHEMICAL BUSINESS HANDBOOK

John H. Perry, Editor

Formerly Development Department, E. I. du Pont de Nemours and Company

1330 pages, 7 x 10,
438 illustrations, $17.00

Here is a worthy companion to Perry's CHEMICAL ENGINEERS' HANDBOOK, with the same sort of thorough coverage and wealth of detail. Each major subject is written by specialists who give you a profusion of fundamentals, facts, and illustrations in concise, handy form—right from large-scale operations down to minor business functions. Quickly and surely you're guided through all phases of finance, control by cost accounting, sales, advertising, commercial development, patent law, industrial toxicology, and a host of other subjects. Here is a complete encyclopedia on the business side of the chemical industries that can be used for both self-training and reference purposes.

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Lukens Steel Co.—W. E. Mullestein to general manager of sales, from manager of field sales.

Foxboro Co.—W. W. Frymoyer, factory manager, has been made a vice-president of the company.

Houdry Process Corp.—George H. Daft, treasurer and comptroller, has been elected vice-president in charge of finance and accounting.

Branches, Distributors

Davison Chemical Division of W. R. Grace & Co. has opened a new office for the southwest and Gulf Coast areas, at 4101 San Jacinto, Houston, Texas.

Bailey Meter Co. has moved the Los Angeles district office to larger quarters. New address is 816 S. Atlantic Blvd., Monterey Park, Calif.

U.S. Stoneware Co. has opened a sales office in Houston, Texas, with Stanley Craig, formerly assistant sales manager for the company, in charge. Address of the new office is at 7621 Brykerwoods Drive.

Fluor Corp. of Canada, Ltd., has opened a new office in Calgary, Alberta. Charles G. Bragg is the resident manager, and P. D. Mellon, the company's Calgary representative until the recent opening, is continuing with the office in an advisory capacity.

The Conoflow Corp. has appointed the Watts Co., Houston, Texas, as sales representative for control elements in southeastern Texas and southwest Louisiana.

Claud S. Gordon Co. has appointed R. L. Springfield, of the Gay Sales Co., 5054 Fieldwood Drive, Houston, Texas, the authorized sales representative in the Houston-Gulf Coast area of the company's equipment for refineries, processing plants, and the metal-working industry.

Babcock & Wilcox Co., tubular products division, has opened a district sales office in Cincinnati, Ohio, at 2330 Victory Parkway. Henry Doctor is the new district sales manager in an area which includes southern Ohio and Indiana, Kentucky, Tennessee, Alabama, Georgia, South and North Carolina, and Florida. Telephone number at the office is Capitol 2530.

Allegheny Ludlum Steel Corp. has opened a tool steel warehouse and district sales office at 3800 N. First St., Milwaukee, Wis.

Cooper-Bessemer Corp. has opened a branch office in Minneapolis, Minn., at 5716 France Ave., South. R. B. Scott is in charge.

Perkin-Elmer Corp., Norwalk, Conn., has opened a new midwest sales and service office, at 230 N. Michigan Ave., Union Carbide & Carbon Bldg., Chicago 1, Ill. The phone at the new office is State 2-5299. John H. Rhodes is midwestern representative for the company.

Penn Industrial Instrument Corp., Philadelphia, Pa., has appointed the Snyder Co., Inc., its representative in Oklahoma and north and west Texas. The Snyder firm has headquarters in Tulsa, Okla., and Odessa, Texas.

Calumet & Hecla, Inc., Wolverine Tube Division, has opened offices in Kansas City, Mo., at Room 208, Broadway-Westport Bldg., 4050 Broadway; the firm's offices in St. Louis, Mo., have been moved to Room 207, Larson Bldg., 25 S. Bemiston Ave.; and larger quarters have been secured for the Philadelphia offices, at Room 1408-10, Liberty Trust Bldg., Broad and Arch Streets.

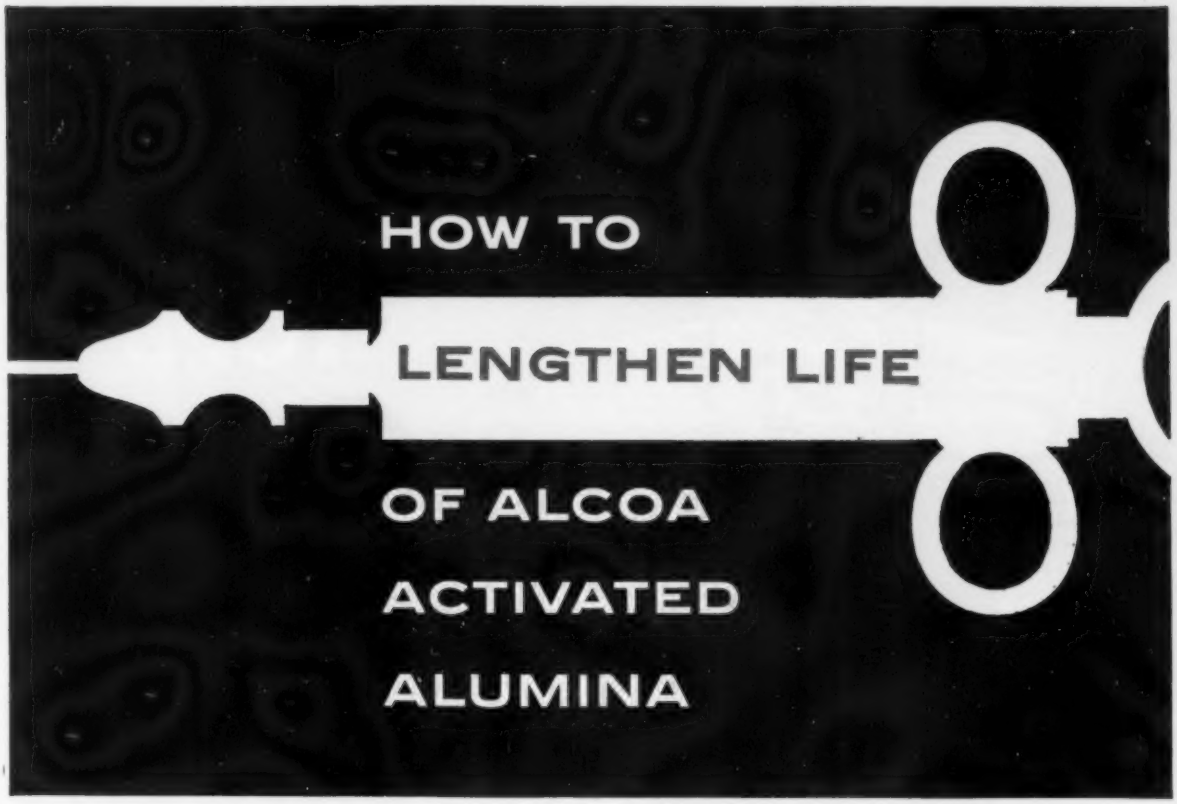
Expansion, Transition

The Lummus Co. has changed the name of its piping division from Piping Supply Division to Fabricated Piping Division.

Crippen & Erlich Laboratories, Inc., Baltimore, Md., formerly the Raymond C. Crippen Research and Development Laboratories, has incorporated and expanded its facilities to handle testing, analysis, research, and development work for fuels, oils, lubricants, and petroleum products.

American District Steam Co., North Tonawanda, N. Y., acquired a west coast operation with the purchase of the California Steel Products Co., located in Richmond, Calif., manufacturers of heat exchangers, boilers, plate and structural items.

Bailey Meter Co. has moved its Cincinnati district office to larger quarters in the city. The new address is 2330 Victory Parkway, Cincinnati 6.



ALCOA Activated® Alumina, the "old reliable" among desiccants, is used to dry everything from furnace atmosphere to wind tunnel "air" and commercial gases. Nearly all of these users obtain longer service life than has been obtained in drying high-pressure natural gas. Here are some hints that will increase the effective life of Activated Alumina in drying natural gas, L.P.G., and petroleum products.

1. Remove Contaminants

After long periods of continued use, dust, fines or any water-soluble impurities such as salt, which may have accumulated, should be hosed out with water. Activated Alumina is completely resistant to action of liquid water. It can be reactivated and immersed again and again without shattering.

Use a precontactor or extractor containing discarded Activated Alumina to remove contaminating material.

Cooling action by shell-and-tube condensing units will coalesce the absorption and compressor oil from vapor phase, reduce much of the oil and reduce water content of the gas.

Avoid caustic carryover. Use a mist extractor to remove caustic spray.

In handling any natural gas, including underground storage, keep it free of oxygen so that it can be dehydrated without danger of deposition of sulphur.

2. Avoid Mechanical Damage

Operating desiccant beds above rated capacity may result in excessive through-put causing turbulence inside dehydrator, blowing a deep crater in top of bed and pulverizing the desiccant. Use a baffle plate to avoid this. If upward flow lifts and abrades entire bed, completely fill top space with ALCOA Tabular Alumina Balls.

Design dehydrators to minimize mechanical vibration to prevent desiccant abrasion.

Release pressure in such a way that gas will pass downward, slowly, through bed.

If screen or support grate fails, use ALCOA Tabular Alumina Balls in layers of properly graded sizes, with small grate supporting largest balls around exit opening.

3. Reactivate Properly

ALCOA Activated Alumina should be reactivated to a minimum temperature of 350° F. Lower temperatures cause heavy fractions and water to linger, reduce adsorptive capacity.

Reactivate promptly after use. Reactivation gas flow should be in the opposite direction from dehydration flow. Liquid trapping should be eliminated. Reactivation by live steam is generally harmful to all solid desiccants and should be avoided.

These hints should help you increase the service life of ALCOA Activated Alumina. For complete details, or answers to your specific drying problems, write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 716-H Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA CHEMICALS

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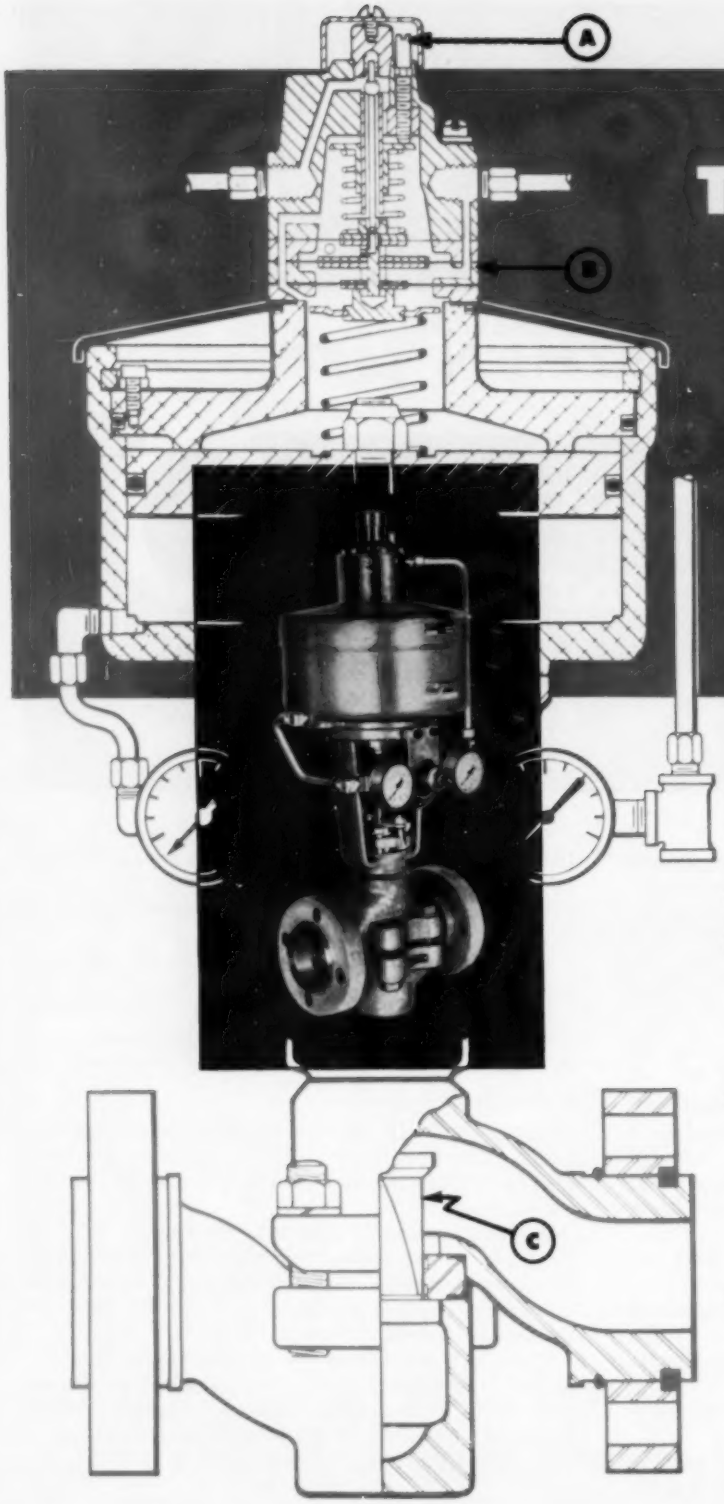
 (To obtain more data on advertised products see page 1260)



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Harvard Students Publish Survey of Aromatics

The Future for Aromatic Chemicals, by William W. Abbott, et al, 8½x11 in., 131 pp., paper binding, $10; copies available from William W. Abbott, McCulloch E-33, Harvard Business School, Boston, Mass.

THE aromatics group is a "dark horse" of the chemical industry. Practically unknown in 1920, these chemicals have today what is virtually an unlimited future, their development being paced only by the researcher's ingenuity in finding new forms and uses for the marketplace. The present volume exists, the authors assert, to fill the sizeable gap in the available factual and analytical knowledge about the aromatics. It was prepared by seven students in connection with their studies at the Harvard Graduate School of Business Administration, though it is not published by the university. It represents an attempt to organize the total picture of the aromatics field in a relatively non-technical presentation for people acquiring their first knowledge of it or for people seeking up to date information from disinterested sources.

After an introductory chapter the book carries a classification of the aromatic chemicals by structure and usage to give the reader an over-all view of the place they occupy in the general field of chemistry. Diagrams of their molecular structure and a glossary of terms conclude the chapter.

The next chapter has information about the current demand for aromatics, presented by classes of chemicals and by end-product uses. A projection is given of the demand over the next 25 years, based on growth trends for the chemicals and their end-products. There follows a description of relationships that exist between the demand for aromatics and their supply, such as the availability of raw materials and the price. Next, the authors try to give a picture of the current major uses of the aromatics and couple this with a discussion of what are the probable and possible uses to be created over the next 25 years.

In chapter six is an analysis and description of the current processes and sources used for obtaining aromatics, such as high-temperature coking, petrochemicals and imports. Recently developed sources and processes are the subject of the next chapter. Among the processes discussed are coal hydrogenation and low-temperature carbonization, and the importance of shale oil and agricultural products as sources of a large group of aromatics is considered.

This information is further developed in the succeeding chapter into an estimate of the portion of total demand expected in 1975 that each of the existing or potential processes will fill. The final chapter offers some suggested guideposts for following the future course of the aromatics, as well as an assessment of the influence they exert on the national economy.

The data compiled in the book were collected by the students through contacts made with people in the field and written reports from both interested and disinterested parties. The use to which this material was put—the organization, analysis and conclusions—is the work of the students themselves and doesn't purport to represent the views of the faculty or the school.

Survey of Solvents In Revised Edition

Toxicity of Industrial Organic Solvents, by Ethel Browning, revised in consultation with the toxicology committee of the Medical Research Council; 6x9¼ in., 411 pp., stiff cloth cover. $8. Chemical Publishing Co., Inc., 212 Fifth Ave., New York, N. Y.

IN 1935 the British Home Office requested that a study be made of the toxicological properties of substances used in industry as solvents. The first step was to survey the existing literature on this subject, and a work with this aim was completed and published in 1937. As the only work of its kind this survey received wide distribution in and outside Great Britain. Consonant with its intention to be a survey the book avoided making any new criticism of the evidence cited, and was useful as a compendium of information. The present volume is the American edition of a revision of the earlier book and contains a bibliography of published literature on toxicity of industrial solvents covering the years up to 1948.

The book is divided into 10 chapters, each dealing with a separate group of compounds. The chapters come in the following order: hydrocarbons, chlorinated hydrocarbons, alcohols, ethers, esters, ketones, glycols and their derivatives, amines and coal tar bases, nitro-compounds, and miscellaneous compounds.

Information is presented about the compounds in a fairly uniform manner. The chemical name and formula head each section, and the first part is devoted to a discussion of its properties. Mention of the processes used to manufacture the substance follows, and a brief summary is given of its industrial uses. The subject of toxicity is introduced by a summary of any conclusions reached by observers, or of the conflicting evidence where no unequivocal conclusions exist, and a discussion of the substance's toxicity as it has been found in specific industrial processes.

The literature is reviewed more exhaustively in the succeeding sections, the first of which presents the results of experimental work on animals. The final section has the reports of the effect of the chemical in question on humans. Symptoms and pathology found in any of the organs or other parts of the body are described, with each reference to published work, in this as in all the sections, fully identified in the bibliography which concludes every chapter.

(More material on toxicity may be found on page 1203 of this issue.)

Proceedings Published of Insulating Oils Symposium

THE fifth symposium on insulating oils, now released in printed form, was part of the June, 1952, meeting of the American Society for Testing Materials, held at Atlantic City, N. J.

The booklet opens with an introduction by L. B. Schofield, Commonwealth Edison Co., and symposium chairman, reviewing the history of the liquid insulation subcommittee of ASTM and introducing the succeeding material. The major portion of the booklet is given to an address by Frank C. Doble, president of Doble Engineering Co., Belmont, Mass., entitled "The Reclamation of Insulating Oils."

The subject is developed by a brief discussion of the background, the necessary terminology, the problems involved and the factors of importance to their solution.

This general treatment is followed by a more detailed description of modern maintenance methods, including tests available and their significance, the various means of reclaiming oil, the effects of inhibition, and the principles upon which an oil maintenance program is based. The test is well illustrated with charts, photographs and diagrams.

Copies of the booklet, designated Special Technical Publication No. 152, may be obtained at $1.25 each from the ASTM headquarters, 1916 Race St., Philadelphia 3, Pa.

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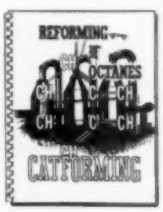


ATLANTIC

It's the Catalyst that counts

International Instrument Congress and Exhibit Scheduled for Philadelphia

In addition to a special session on instrumentation for production processes set up by the Instrument Society of America's petroleum subcommittee, the program for the two-week First International Instrument Congress and Exposition in Philadelphia, September 13-24, covers many subjects and papers of high interest to the petroleum and petrochemical instrument engineer.

Three papers will be presented during the petroleum subcommittee's session on Wednesday morning, September 15. They include:

"Concept and Practice of Coordinated Control Systems," by Stanley W. J. Wallis, Anglo-Iranian Oil Co., Ltd., London, England.

"Why Electronic Process Control?" by David M. Boyd, Jr., Universal Oil Products Co., Des Plaines, Ill.

"The Measurement of Flow with Density Compensation as Applied to Liquids and Gases," by Henry W. Stoll, Taylor Instrument Cos., Rochester, N. Y.

A total of nearly 240 papers will be presented during the 82 sessions of the International Congress. In addition, there will be 13 different panels and symposia on specific topics, as well as the regular annual maintenance clinic (scheduled for Friday, Saturday, and Sunday, September 17-19) and the clinic on analytical instruments (Monday, Tuesday, and Wednesday mornings, September 13-15).

Other papers and sessions of interest to the petroleum or petrochemical man include such subjects as: mass spectrometry; safety interlocks; cost vs. performance in process control; maintenance of pH equipment; infrared analyzers; radioactivity instruments; flow measurement; and many others.

Special panels are to be held on problems of high interest, including: instrumentation for hazardous locations; the economics of instrumentation; and automation.

The panel discussion on economics will include the following authorities as participants: Harry F. Moore, Standard Oil Development Co.; H. C. Frost, Corn Products Refining Co.; E. I. Thomas, Carbide and Carbon Chemicals Co.; Albert F. Sperry, Panellit, Inc.

The exhibition and all the technical sessions will be at Philadelphia's Commercial Museum and Convention Hall. Conference headquarters are to be at the Benjamin Franklin Hotel. Free bus transportation will be provided between the hotel and the Convention Hall.

The conference is sponsored by the Instrument Society of America, with the following technical and scientific organizations co-operating: American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Physics, American Institute of Chemical Engineers, American Microscopical Society, Institute of Radio Engineers, American Society for Photogrammetry, Society for Experimental Stress Analysis, as well as several foreign groups.

Philips To Hold 2nd X-Ray School on West Coast

For the second successive year North American Philips Co., Inc., will duplicate the program given semi-annually in the east when it presents the Western X-ray Diffraction School at the Sir Francis Drake Hotel, San Francisco, the week of August 30 to September 1.

Morning sessions of the school will be devoted to lectures, and in the afternoons there will be laboratory demonstrations with the latest types of equipment. Instruction will be given in the operating techniques of the powder camera, the X-ray diffractometer (diffraction goniometer), and the X-ray spectograph (fluorescence analysis).

On Friday, September 3, the school will devote the day to actual application problems from the field, and speakers will discuss details of methods currently in use around industrial laboratories and plants.

Attendance at the X-ray Diffraction School is without charge, and persons interested in registering should contact the North American Philips Co. or any of the company's dealers.

AIEE Committee Schedules Petroleum Conference

A broad coverage of the petroleum industry—including oil, gas and petrochemicals—from the standpoints of production, refining and transportation is planned at the technical conference to be sponsored by the petroleum committee of the American Institute of Electrical Engineers. The conference will be held in the Mayo Hotel, Tulsa, Okla., September 27-29. Nineteen papers covering electrical design, application and maintenance are to be presented by electrical engineers in the petroleum industry.

A joint luncheon with the Tulsa Engineers Club is planned for Monday, September 27, and the speaker on this occasion will be the governor of Oklahoma, Hon. Johnston Murray. A stag banquet Tuesday evening will be addressed by the newly elected AIEE president, A. C. Monteith, Westinghouse Electric Corp., Pittsburgh, Pa. Inspection trips are planned for Wednesday afternoon.

Arrangements for hotel reservations, pre-registration forms and a complete listing of the papers and program can be made through M. C. Callahan, Gulf Refining Corp., Northern Pipe Line Division, P.O. Box 661, Tulsa 2, Okla.

Canada Bids for Annual API Refining Division Meeting

The general committee of the American Petroleum Institute's Division of Refining has received an invitation from Canadian representatives to schedule a mid-year meeting of the Division in Canada. It has tentatively suggested 1956 or 1957 for such a location. The 1955 mid-year meeting will be held May 9-12 at the Jefferson Hotel in St. Louis, Mo.

Oil Man's Calendar

AUGUST

Oil-Shale Conference, U.S. Bureau of Mines, University of Wyoming Science Summer Camp, near Laramie, Wyo., August 10-13.

West Virginia University, 14th annual Appalachian gas measurement short course, Morgantown, W. Va., August 23-25.

International Symposium on Combustion, University of Pittsburgh, Pittsburgh, Pa., August 30-September 3.

SEPTEMBER

Natural Gasoline Assn. of America, Oklahoma regional meeting, Skirvin Hotel, Oklahoma City, September 17.

1st International Instrument Congress and Exposition, Commercial Museum and Auditorium, Philadelphia, Pa., Sept. 13-24.

National Petroleum Ass'n, 52nd annual meeting, Hotel Traymore, Atlantic City, N. J., September 15-17.

American Institute of Electrical Engineers, first conference on the petroleum industry, Tulsa, Okla., September 27-29.

American Society of Mechanical Engineers, ninth annual petroleum mechanical engineering conference, Statler Hotel, Los Angeles, Calif., September 27-30.

Information Offered in the Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data being offered in this issue's advertisements.

AMMONIA, Anhydrous, to neutralize oil acids, available in various quantities, guide describes uses; Nitrogen Div., Allied Chem. & Dye Corp. See adv't. p. 1165.

BLENDERS, automatic, multiple component, bulletin SM-2060 and other data available; Proportioneers Div. B-I-F Industries. See adv't. 2nd cover.

BORON FLUORIDE for many catalyst uses, available in different quantities, information available; Baker & Adamson, Gen'l. Chem. Div., Allied Chem. & Dye Corp. See adv't. 3rd cover.

CATALYTIC CRACKING units, "Houdriflow", descriptive brochure and flow diagrams on request; Houdry Process Corp. See adv't. p. 1180.

CLAD STEEL for refinery fabrications, color movie "Equip For New Profits" available; Lukens Steel Co. See adv't. p. 1152.

CLEANING, industrial, for drums and tanks, handbook on request; Oakite Products Co. See adv't. p. 1236.

COMPRESSORS, various horsepower, bulletin describes complete line; Cooper-Bessemer Corp. See adv't. p. 1279.

COOLING TOWERS, single flow, bulletin CF-54; The Marley Co. See adv't. p. 1242.

COOLING TOWERS, booklet "Cooling Water For Industry"; The Fluor Corp., Ltd. See adv't. p. 1267.

DRYING EQUIPMENT, for gas, air, organic liquids, booklet "Because Moisture Isn't Pink"; Pittsburgh Lectrodryer Corp. See adv't. p. 1183.

ENTRAINMENT SEPARATORS, wire mesh type, Case study 1003 available; Otto H. York Co. See adv't. p. 1288.

FIRE PROTECTION, liquid foam, three types, booklet "Foam Fire Protection"; National Foam System, Inc. See adv't. p. 1177.

FITTINGS, tube, "Swagelok", catalog available; Crawford Fitting Co. See adv't. p. 1290.

FITTINGS, welding, for alloy piping systems, new bulletin; Key Co. See adv't. p. 1287.

FLOW MEASUREMENT, automatic batching with "Fluidometer," bulletin F1-49; Hetherington and Berner, Inc. See adv't. p. 1238.

FLOW METER, "Transometer" for measurement and control of viscous fluid, bulletin 125; Askania Regulator Co. See adv't. p. 1275.

FLUID COOLERS, dry type, vertical and horizontal discharge, bulletin DS-395 gives information; The Trane Co. See adv't. p. 1272.

GAGES, liquid level, low temperature, non-frosting, literature available; Jerguson Gage and Valve Co. See adv't. p. 1233.

GENERATOR, oxygen-nitrogen, for low temperature processing, brochure available; Air Products, Inc. See adv't. p. 1271.

GRATING AND TREADS, aluminum, for walkways and platforms, data bulletin 10-P; Washington Aluminum Co. See adv't. p. 1251.

HEAT EXCHANGERS, evaporative cooling, bulletins 120 & 124; Niagara Blower Co. See adv't. p. 1265.

INFRARED ANALYZER for continuous automatic analysis, descriptive folder; Phillips Petroleum Co. See adv't. p. 1170.

INSULATION, "Mono-Block" for temperatures up to 1700° F., bulletin on request; Baldwin-Hill Co. See adv't. p. 1278.

MAINTENANCE EQUIPMENT, for tubes, information available; Airetool Mfg. Co. See adv't. p. 1247.

MIST ELIMINATORS, wire mesh type, catalog on request; Metal Textile Corp. See adv't. p. 1280.

MIXERS, side and top entering, nine bulletins available on request; Mixing Equipment Co. See adv't. p. 1184.

MOTOR STARTERS for hazardous locations, booklet 1062; Electric Controller & Mfg. Co. See adv't. p. 1150.

OVENS, laboratory type, many models, catalog 331A; Precision Scientific Co. See adv't. p. 1276.

PACKING for valves and pumps, "Teflon" and other types, catalog TP-1053; U. S. Gasket Co. See adv't. p. 1282.

PAINT, aluminum, booklet tells how to paint with aluminum, Aluminum Co. of America. See adv't. p. 1161.

PAINT, for the petroleum industry, booklet "Finish Selection Guide"; Sherwin-Williams. See adv't. p. 1270.

PETROCHEMICAL PLANT construction, booklet describes new installation; J. F. Pritchard Co. See adv't. p. 1151.

PIPE, fittings and valves, corrosion resisting, "Saran-Lined," catalog available; Dow Chemical Co. See adv't. p. 1266.

PRESSURE REGULATOR, large capacity, various sizes and types, bulletin C-95 describes new features; Fisher Governor Co. See adv't. p. 1157.

REFORMING, catalytic, brochure "Catforming"; Atlantic Refining Co. See adv't. p. 1256.

SCALE MODELS, refinery and industrial construction, detailed brochure; Industrial Models, Inc. See adv't. p. 1237.

STEAM TRAPS, catalog available; Armstrong Machine Works. See adv't. p. 1160.

SWING JOINTS, steel, many styles and sizes, catalog 400; Barco Mfg. Co. See adv't. p. 1277.

TUBES, condenser, of many metals and types, booklet on request; Wolverine Tube. See adv't. p. 1158-1159.

TURBINES, mechanical drive, bulletin GEA-4955A; General Electric Co. See adv't. p. 1162-1163.

TURBINES, vertical and horizontal, catalog 500; Dean Hill Pump Co. See adv't. p. 1166.

VALVES, control, air motor driven, catalog LB-1; Conoflow Corp. See adv't. p. 1254.

VALVES, control, multiple plug, bulletin 101-B; Hammel-Dahl Co. See adv't. p. 1240.

VALVES, control, single seat, catalog 1500B; The Annin Co. See adv't. p. 1171.

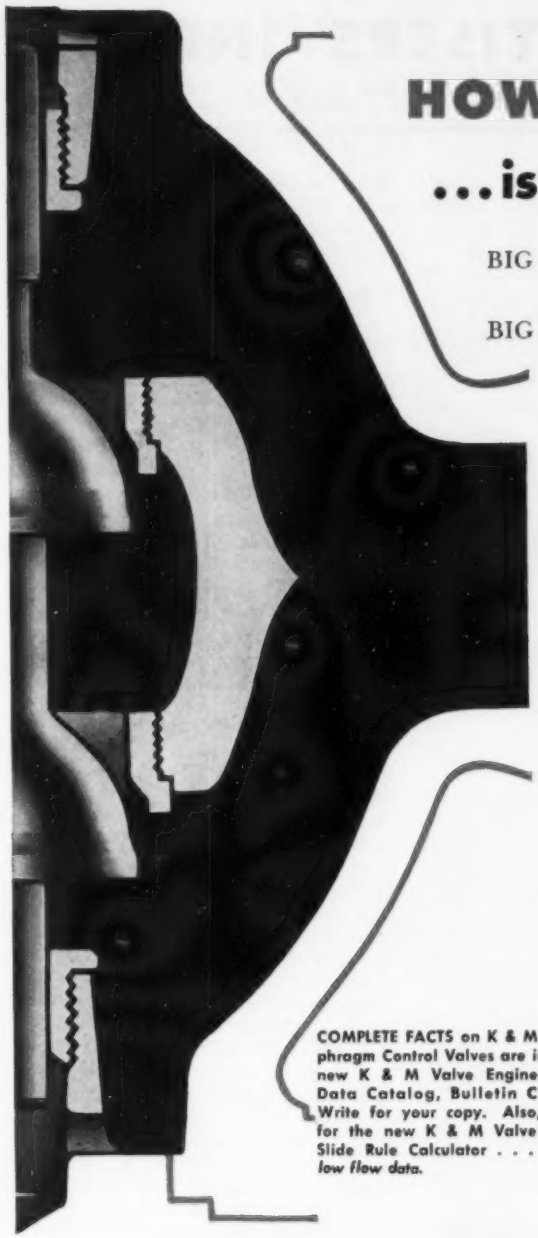
VALVES, diaphram control, bulletin CV53 and valve size calculator on request; Kieley & Mueller, Inc. See adv't. p. 1259.

VALVES, needle and other types, small sizes, information available; Hoke, Inc. See adv't. p. 1286.

VALVES, plug, visible shut-off, catalog available; Hamer Valves, Inc. See adv't. p. 1248.

VALVES, tapered plug, "Lever-Seald", catalog 39-3, Homestead Valve Mfg. Co. See adv't. p. 1273.

WATER SEPARATORS, provides continuous coalescing, process manual R-101-53; Warner Lewis Co. See adv't. p. 1251.



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C_V COMPARISON TABLE

Valve Size	K & M	Valve B	Valve C
¾"	10.9	8.4	8
1"	17.3	14.9	12
1½"	39.1	33.2	28
2"	61	57	48
2½"	97.7	71.0	72
3"	150	116	100
4"	219	197	165
6"	500	364	360

Based on the maximum C_V at rated travel through the valve body. From manufacturers most recent slide rules or tables.

diaphragm control valves

K&M

Valve Makers Since 1879

KIELEY & MUELLER, INC.

64 Genung Street
Middletown, New York

ADVERTISERS' INDEX

This index is published as a convenience to the reader. Every care is taken to make it accurate, but PETROLEUM PROCESSING assumes no responsibility for errors or omissions.

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card . . . no postage is required.

The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.

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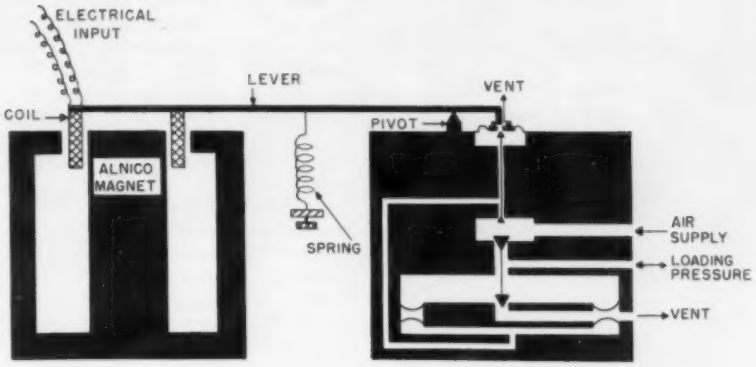
CLASSIFIED
H. E. Hilty, Mgr.

EMPLOYMENT 1281

WHAT'S NEW . . .



New Relay Stops Transmission Lags

A new electro-pneumatic transducer designed to operate with the "Autronic" Control System, the Type P2R Power Relay is said to eliminate the transmission lags common to pneumatic control systems. It takes the electrical output from an Autronic controller or a manual control and converts it to an air-loading pressure proportional to the electric current.

This permits utilization of low-cost, flexible, air-operated valves. No electric motors, boosters, or slide wires are employed. The equipment can be made explosion-proof if it is desired.

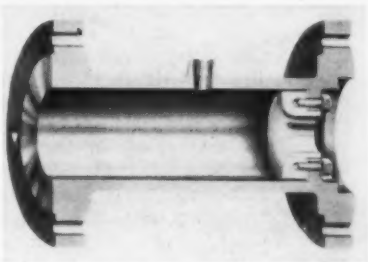
Process variables are converted into a small AC voltage by the primary element transmitter and acted upon by a selective wide range of control actions in the controller. Controller DC output, which is transmitted to the power relay, is of a value which is fundamentally governed by the primary element transmitter but which is continuously modulated by the proportional, reset, and rate-time actions of the controller. Large mechanical power amplification at the final control element is obtained by the P2R power relay.

The relay operates on the null-balance principle. The electrical side consists of a moving coil in a permanent magnet field, and is adjusted so that a 4 milliamp. current gives an air-loading pressure of 3 psi., and an 8 milliamp. current produces a 15 psi. output with a direct-acting relay. Other higher air pressure ranges are available. The unit can be used either reverse- or direct-acting. The Swartout Co., 18511 Euclid Ave., Cleveland 12, Ohio.

Circle No. **1** *on Reply Card*

For More Information

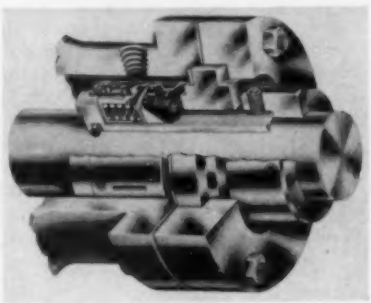
Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the number corresponding to the number at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage is required.



Simple Design Feature of New Flowmeter for Steam, Gases

. . . where high accuracy and stability of operation are desired. The King "Critiflo-Meter" can be used for measurement and control of the flow of steam and other gases in petroleum, petrochemical, and similar industries; for steam proportioning, and so on. It consists of two simple parts: 1) a housing containing a nozzle made from chrome carbide or hardened stainless steel, and 2) a flow indicator connected to the housing. The instrument needs little maintenance and can be readily installed in any piping system. Housings are available in pipe sizes from 2 to 10 in. inclusive, for pressures up to 900 psi., and flow rates ranging as high as 300,000 lb./hr of dry and saturated steam. The meter operates under any condition where the ratio of absolute pressure upstream (in the housing) is equal to, or less than, the so-called critical pressure ratio for the fluid measured. Under this condition, the fluid moves through the nozzle throat at sonic velocity—neither more nor less; and variations in downstream pressure have no effect on the rate of flow, so long as the critical pressure ratio is not exceeded. Thus, weight flow is directly proportional to upstream pressure, and a simple gage measuring only this pressure can be used to measure flow rate. Accuracy of the readings depends solely on the accuracy of the indicator or recorder used. King Engrg. Corp., Ann Arbor, Mich.

Circle No. **2** *on Reply Card*



Shaft Seal Can Be Replaced Quickly on Split-case Pumps

. . . in the event of seal failure. The new "John Crane" Type 9 mechanical shaft seal is mounted on a sleeve with an outside clamping ring, as illustrated. This permits fast installation and/or removal in practically all modern split-case centrifugals, in that it is not necessary to unbolt the top of the horizontal split shell. The seal can be used to handle virtually all corrosive liquids at temperatures up to 500° F. Flexible sealing members are made of chemically inert Teflon. Springs and metal parts can be furnished in the metallurgical specifications best suited to the service. Sizes are available to specification. According to performance data recently compiled, all cargo pumps of an East Coast oil tanker were equipped with a special adaptation of the Type 9 seal for service in 11 round-trip voyages between Philadelphia and Texas. On completion of the trips, inspection of all pumps

showed there had been no leakage. Crane Packing Co., Dept. PPN, Chicago 13, Ill.

Circle No. **3** *on Reply Card*

New Drafting Tape Applies Easily but Comes off Cleanly

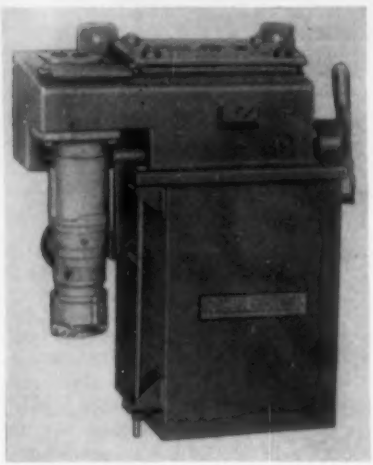
. . . yet will hold tracing paper or cloth firmly to the board. It will also leave no defacing or discoloring marks on the drafting paper or cloth. It has been found to resist breaking off during unrolling and application, yet it will tear crosswise readily enough so that the user needs no scissors. Called "Behr-Cat" No. 114 Drafting Tape, it is available in 60-yard boxed or bulk-packed. There are 17 standard widths ranging from ¼ to 3 in. Behr-Manning Corp., Troy, N. Y.

Circle No. **4** *on Reply Card*

Drum Clamp Permits Efficient Lifting, Carrying, Stacking

. . . by fork-lift truck. Controlled completely from the operator's seat, this new hydraulic mechanism can pick up and deposit one or two drums at any height within lifting range. Special curved arms fit the contours of drum sides. Each arm is covered on its inner surface with a ribbed rubber, which grabs and holds the load and protects drums from damage. When the truck is required for other types of materials, the clamp is easily interchanged with other clamps. Or the hydraulic operating mechanism can be detached so standard forks can be installed. Towmotor Corp., 1226 East 152nd St., Cleveland 10, Ohio

Circle No. **5** *on Reply Card*



Oil-Immersed Power Outlet Incorporates Safety Interlock

. . . on the switch handle and plug, manually operated, that prevents the insertion or removal of the plug while the switch is in the "on" position. This eliminates the possibility of an accidental shut-off of circuit power: the power source must be opened by throwing the safety switch before the plug can be removed. The Rowan type 620-A3GX outlet has a switch featuring: sealed off terminal compartment and safety jack; provision for padlocking the switch in "off" position; top and bottom conduit entrance; and manually operated disconnect switch of the contractor type with quick make and break mechanism. The plug and receptacle unit is a Crouse-Hinds type AR Arktite. Depending on size requirements, either 30-, 60-, or 100-amp. units are used. In addition, the plugs can be safely pulled while under load, without damage to equipment. Crouse-Hinds Co., Wolf & 7th North Streets, Syracuse, N. Y.

Circle No. **6** *on Reply Card*

New Process Developed to Clad Nickel in Tailored Thicknesses

. . . by electrodeposition. The "Lectro-Clad" process is said to offer fabricators and users of nickel clad steel substantial savings in material costs. Steel plates and sheets ranging in thickness from ⅛ to ¾ in. or more can be clad with nickel on either or both sides in thickness of cladding from 0.0006 to 0.020 in., without regard to the thickness of the steel. The new technique eliminates the limitation of 5% nickel on sheets of ½ in. or less in thickness. Manufacturer states the petroleum industry is showing interest in the material for use in storage tanks and process vessels. Deposits of 0.006 to 0.010 have been very successful in controlling contamination; while heavier claddings, up to 0.020 in., are useful in combatting corrosion in handling sweet or sour distillates. Sheets and plates in sizes up to 7 by 20 ft. are now being produced on a mass production basis. Bart Manufacturing Corp., Belleville, N J

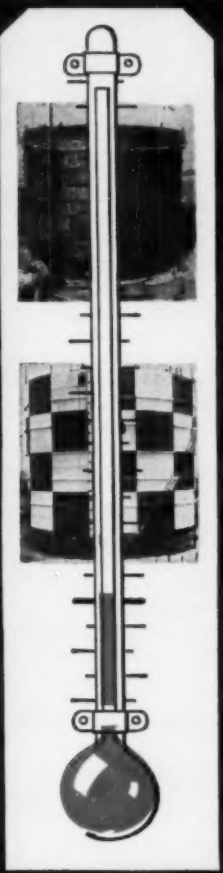
Circle No. **7** *on Reply Card*

Instantaneous Vacuum Gauge Is Offered in Panel-Mount Model

. . . covering the range of 1 to 1000 microns Hg. Employing a patented principle of directly heated thermocouples, the instrument is designed for test panels in such applications as vacuum pumping and the like. The gauge has noble metal thermocouples and nickel-plated gauge tubes which afford freedom from outgassing, system contamination, and corrosion. Calibration of gauge tubes is not affected by changes in ambient temperature or exposure to atmospheric pressure. Because the sensing element thermocouples are directly heated, they reach operating temperature within one-half a second. The instrument measures 7 in. high, 7½ in. wide, and 2¼ in. deep, and it weighs 3½ lbs. Hastings Instrument Co., Inc., Warwick, Va.

Circle No. **8** *on Reply Card*

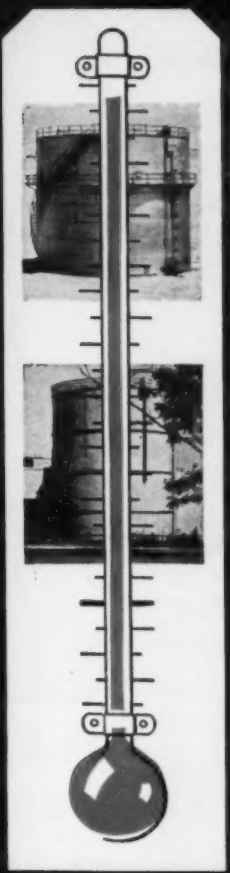
from the **ARCTIC** to the **TROPICS**



more than

130

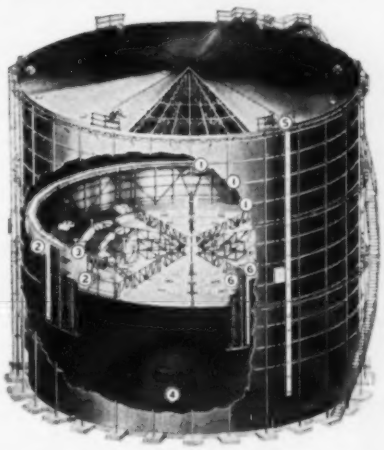
WIGGINS GASHOLDERS have eliminated operating costs for users of chemical process and industrial gases



This 100% dry seal gasholder (no water, no tar, no grease) has proved itself under every condition of climate and temperature. Because of the seal and the simple operating mechanism, operating costs have been entirely eliminated. Comparison of maintenance expense by owners of Wiggins gasholders also shows remarkable savings. Companies who have converted old-type gasholders to the Wiggins advantages have been able to enjoy similar savings. Write for information.

PISTON RISES NEARLY TO TOP—MINIMUM OF WASTE SPACE
CAN BE BUILT ANY SIZE • NO CONTAMINATION OF GAS

1. Space above piston completely ventilated
2. Wide clearances simplify operation.
3. Gas-tight frictionless seal not affected by weather.
4. Piston rests on bottom when empty—less than ½ of 1% dead space for purging.
5. Leveling device—independent of side wall—keeps piston level.
6. Fenders prevent all tension in seal.



Wiggins Gasholder

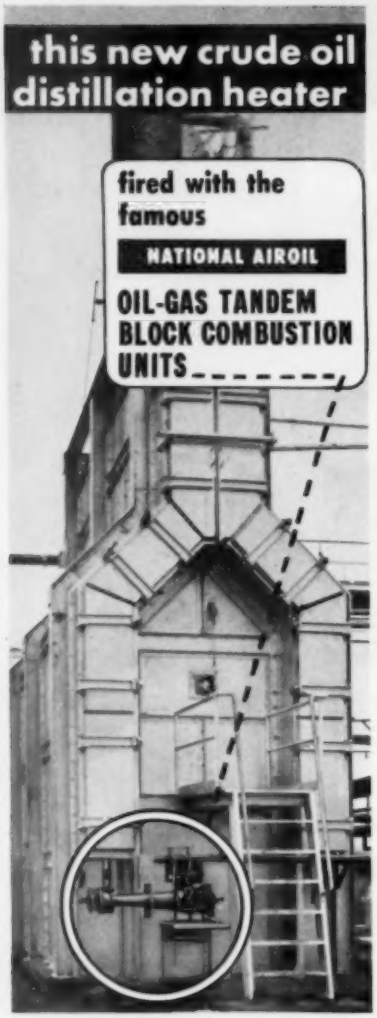
by GENERAL AMERICAN

WIGGINS VAPOR SEALS
GENERAL AMERICAN
TRADE MARK

General American Transportation Corporation
135 SOUTH LA SALLE STREET • CHICAGO 90, ILLINOIS

Offices in Principal Cities

Export Dept.: 380 Madison Avenue, New York 17, N. Y.
Plants: Birmingham Ala. • East Chicago, Ind. • Sharon, Pa.
In Canada: Toronto Iron Works, Ltd., Toronto, Ontario



...MEANS MANY MORE HOURS ON STREAM WITHOUT SHUTDOWN

This heater (RJ Oil & Refining Co., Inc., Princeton, Indiana) is fired from each end with one of NATIONAL AIROIL's #2 combination oil and gas, patented, Tandem Block Combustion Units.

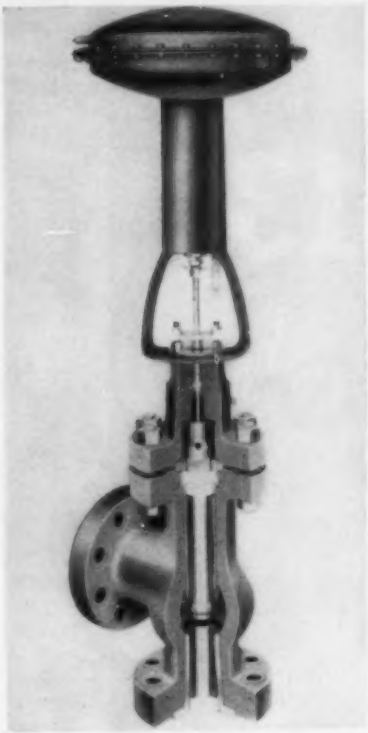
The Tandem Unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame . . . maintains required temperature using either fuel . . . radiates heat uniformly without tube impingement. With the Tandem Unit's clean flame, a cold furnace can be brought to full capacity in a shorter time.

You will realize more satisfaction from YOUR heaters when NATIONAL AIROIL Tandem Combustion Units are specified.

CHEMICAL-PETROLEUM DIVISION

NATIONAL AIROIL BURNER CO., INC.

1297 East Sedgley Ave., Philadelphia 34, Pa.
Southwestern Division: 2512 So. Blvd., Houston 6, Tex.



New Angle Valves Have Tight Shut-off and Balanced Control

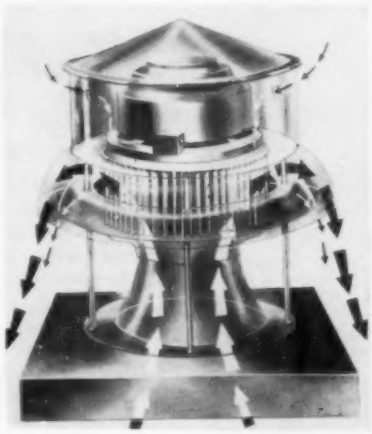
. . . at high pressure differentials. The valves use Venturiflo design and in addition eliminate the plug unbalance usually associated with single seated valves, according to the manufacturer. The force caused by the line pressure working against the cross sectional area of the plug is cancelled out by means of a drilled hole along the axis of the plug, intersecting radially drilled holes near the top. Thus, the line pressure is transmitted through this passage and exerts a downward force on the plug equal to the upward force. As a result, the valve may be positioned accurately at pressure differentials as high as 3600 psi. with standard superstructures actuated by standard instrument air output. Tight shutoff is attained by sealing the pressure in the body bowl from the balancing chamber with an especially designed seal. With the plug on its seat, the line fluid would normally tend to flow through the space between the plug and guide and continue through the drilled passage to the downstream side. This is prevented by interposing a seal around the plug near the top of the guide. The seal is made of an inert, frictionless plastic. Valves are made in sizes from 1 to 8 in. with body ratings from 150 to 1500 lb. ASA Standard at a temperature rating of 450° F. Hammel-Dahl Co., 175 Post Road, Providence 5, R. I.

Circle No. **9** *on Reply Card*

Teflon Protects Thermocouple Against Corrosive Materials

. . . in new thermocouple gland design. The Model TG-14T incorporates a butt-welded thermocouple covered with a thin-walled Teflon tube, yet is said to have fast response (an average thermal-time constant of 4.5 seconds). It is designed for pressures up to 5000 psi. at temperatures from —90 to +500° F. The outside of the Teflon tube is sealed in the gland by the mechanical compression of a double-bore Teflon bushing around the tube and inside the stainless steel gland. The tube is not crushed because it is internally supported by the thermocouple wire passing through it. The gland itself is made entirely of Type 303 stainless steel. Thermocouple wires, 18 gage, of either iron-constantan or copper-constantan calibration are available as standard stock items. Immersion depth of the hot junction can be furnished to any desired length. On lengths greater than 2 or 3 inches, open end stainless steel protection tubes can be furnished to support the hot junction. Conax Corp., 4515 Main Street, Buffalo 21, N. Y.

Circle No. **10** *on Reply Card*

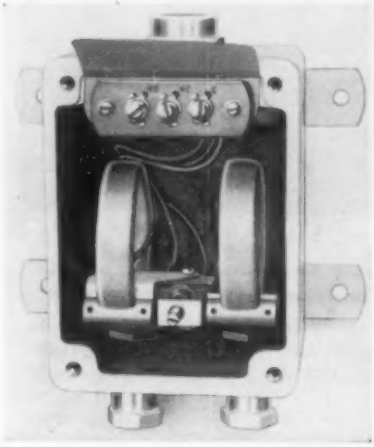


Air "Curtain" Shields Motor From Hazardous Fumes, Gases

. . . being handled by the ventilating fan it drives. The result is a power exhauster providing safety from explosion in handling possibly combustible materials without resort, in most cases, to an explosion-proof motor. This is expected to permit applications of the unit in chemical plants, refineries, laboratories, sewage treatment

units, etc. The positive air seal-off is accomplished by the action of the squirrel-cage fan, located immediately below the motor chamber, which draws a current of fresh air down through the motor hood and over the motor and motor shaft, thus sealing the chamber off from the main air flow below and preventing any vapors, fumes, or gases from reaching the motor while it is operating. The new "Air-Van" exhausters use the Fairbanks-Morse axial air gap electric motor, which is only half the size and weight of the conventional motor. The exhausters are being built in sizes from ¾ to 5 hp., with air capacities up to 12,000 CFM. Gallaher Co., Omaha, Neb.

Circle No. **11** *on Reply Card*

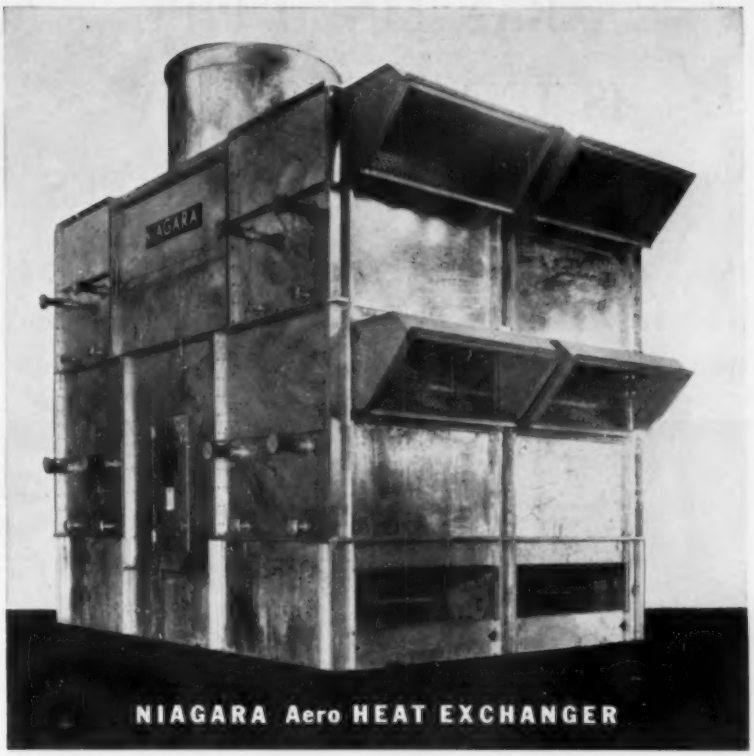


New Pressure Switch Operates In Range from 15 to 10,000 psi

. . . on increasing or decreasing pressure differences at any point within the adjustable range of the model selected. The Model 532 senses a difference between two variable pressures or a variable and a reference pressure. It is available in four classes of proof pressures from 500 to 12,000 psi. Two parallel Bourdon tube sensing elements provide high repetitive accuracy, it is said. The unit will operate in any position; no balancing or leveling is necessary. Entire mechanism is housed in a splash-proof enclosure. A tamper-proof external adjustment is provided for field setting. The unit incorporates an Underwriters' Laboratory approved snap action, single pole, double throw, switching element rated for AC and DC circuits. It is recommended to operate relays, solenoids, motor controls and other similar devices. Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, Calif.

Circle No. **12** *on Reply Card*

Thirty Million B.T.U. CAPACITY



Cooling in Chemical Processes with Precise Control of Temperature

The NIAGARA Aero HEAT EXCHANGER cools liquids and gases by evaporative cooling with atmospheric air, removing the heat at the rate of input, controlling temperature precisely. You save 95% of cost of cooling water; you make great savings in pumping, piping, power; quickly recover your installation cost.

You can cool and hold accurately the temperature of all fluids, air and gases, water, oils, solutions, chemical intermediates, coolants for mechanical, electrical and thermal processes. You obtain closed system cooling free from dirt. You solve all the problems of water availability, quality or temperature.

In CHEMICAL PROCESSES this is successfully used in cooling liquids and gases, chemical reactions, condensing distillations and reflux cooling.

Write for complete information; ask for Bulletins 120 and 124. Address Dept. PP.

NIAGARA BLOWER COMPANY

405 Lexington Ave. New York 17, N. Y.

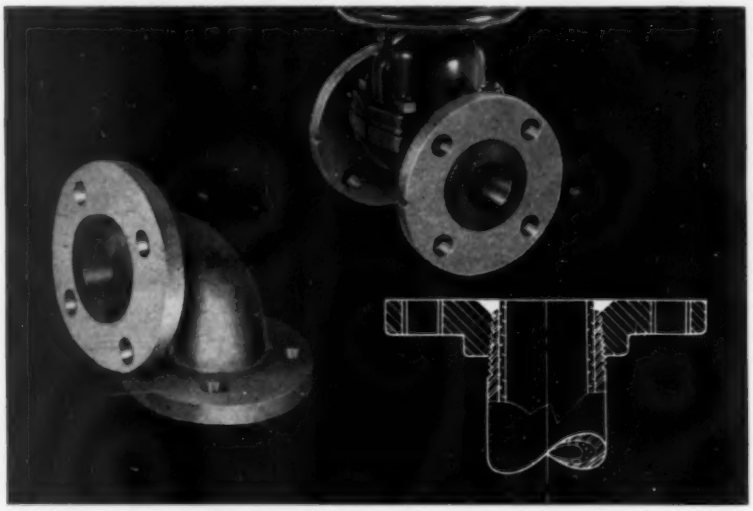
District Engineers in Principal Cities of United States and Canada

(To obtain more data on advertised products see page 1260)

DOW

SARAN LINED PIPE IS UNAFFECTED BY SOUR CRUDE DISTILLATES

Saran lined pipe, fittings and valves resist corrosive end-products and acidic treating agents . . . eliminate production losses and downtime for replacements



The various corrosives encountered in the production of gasoline, kerosene and fuel oil from sour crudes point up another cost-saving application of saran lined pipe, fittings and valves. The other corrosives used in oil processing installations such as sulfuric acid, hydrofluoric acid and ferric chloride are all handled equally well. Downtime is cut to a minimum because this steel-clad rigid pipe has high pressure strength and great durability under severe conditions—which means dependable long-time service. Easily installed, saran lined steel pipe can be cut and threaded on the job—almost as quickly as dimensions can be taken! Wherever superior resistance to corrosives is required, be sure to consider saran lined pipe, fittings and valves. We'll be glad to assist with installation plans. Contact your nearest Dow sales office or write THE DOW CHEMICAL COMPANY, Midland, Michigan.

RELATED SARAN PRODUCTS—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

Dow Chemical Company, Midland, Mich.
Plastics Sales Department, SP-1165G-1
Please send me a copy of your catalog on saran lined pipe, fittings and valves.

Name_____

Title_____

Company_____

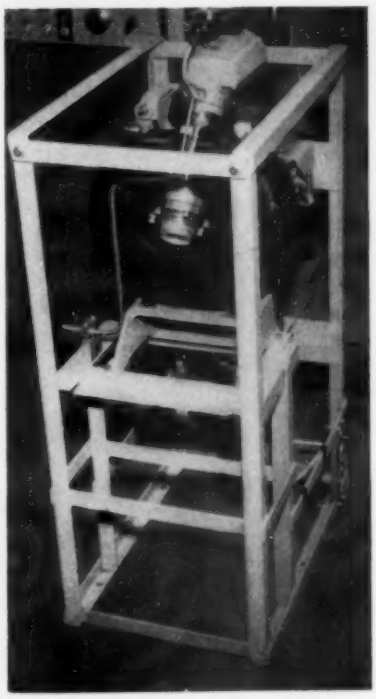
Address_____

City_____ State_____

you can depend on DOW PLASTICS

DOW

What's New!



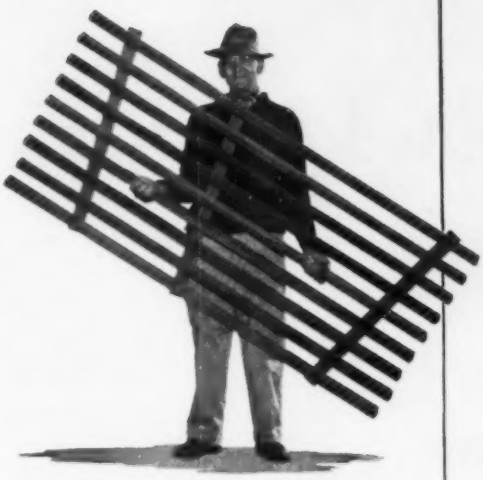
New Cycloidal-Focusing Mass Spectrometer Has High Speed

. . . and wide application in the petroleum, petrochemical, and chemical processing industries. The Model 21-620, a result of two years of intensive research, is designed for process streams, including continuous monitoring as well as conventional laboratory applications. In process control, it may be coupled directly into the stream. The cycloidal focusing of ions depends upon ion mass and the strength of crossed uniform electric and magnetic fields, and is independent of the velocity or direction of motion of the injected ions. Quantitative separation may be obtained from mass 2 through mass 150. Scanning is possible to mass 180. Spectra are presented on pen-and-ink recordings, showing as peaks the distribution and relative quantity of ions resulting from conventional electron bombardment. Interferences between these because of distortion due to ion energy spread encountered in other spectrometers has been eliminated by the independence of initial ion energies in the cycloidal instrument.

The new instrument is designed as a twin of the manufacturer's Model 21-610. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.

Circle No. **13** *on Reply Card*

Examine the filling of a
FLUOR COOLING TOWER
and get the whole story



Fluor uses only 100% clear all heart redwood for filling

Fluor grid decks are not only sturdily built but are made from the highest grade redwood lumber—100% clear all heart redwood—the finest cut of the log. Clear all heart redwood is free from defects and sapwood and under normal controlled water conditions will give many many years of trouble-free service. We invite you to investigate our filling before making your selection of a cooling tower.

On an average, the price of a cooling tower is based 30% on the mechanical equipment and about 70% for lumber and fabrication. For example, in a Cooling Tower costing $200,000, the mechanical equipment will amount to approximately $60,000 and the tower structure about $140,000. Of this $140,000 about 30% (or $42,000) consists of the filling (grid decks) inside the tower which breaks up the water for greater exposure to air.

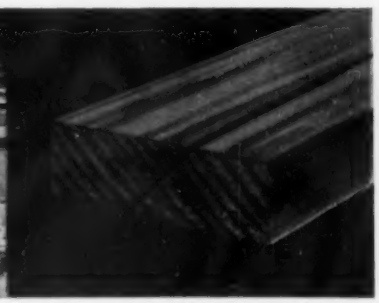
The filling is in reality the heart of the tower and its design and construction is of utmost importance. All Fluor Tower filling is mill cut and assembled into grid panels, 2 ft. 10″ wide x 5 ft. 11½″ long. Nine bars are nailed (with 6 penny copper nails) to three 1x2 cross cleats. The bars are cut on a 25% bevel from 1 x 3 boards; each bar averages 1″ x 1½″. Grid panels are strong enough to support three 200 lb. men and are actually used as scaffolding during tower erection and inspection. You get more years from a tower with this kind of filling.

Write for illustrated bulletin "Cooling Water for Industry."

FOUNDER MEMBER CTI COOLING TOWER INSTITUTE

Grid decks easily support three 200 lb. men

A 20-cell Fluor induced-draft cooling tower



A 1x3 makes two bars for Fluor grid decks

BE SURE WITH

FLUOR

THE FLUOR CORPORATION, LTD
LOS ANGELES 22, CALIFORNIA
FLUOR OF CANADA - TORONTO
FLUOR PERUANA, S.A. - LIMA
HEAD WRIGHTSON - LONDON

ENGINEERS
CONSTRUCTORS
MANUFACTURERS

NEW YORK
CHICAGO
PHILADELPHIA
BOSTON
PITTSBURGH
SAN FRANCISCO
HOUSTON
BIRMINGHAM
TULSA

(To obtain more data on advertised products see page 1260)

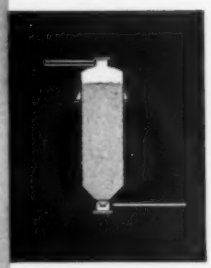
ATTAPULGUS Fullers Earth

POROCEL Activated Bauxites

. . . reliable sorptive minerals for petroleum and chemical processing

WANT TO PURIFY BY ADSORPTION?

There's an Attapulgus or Porocel adsorbent to fit your process technique for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from process liquids or gases. Materials treated in principal applications are: motor oils and other lubricating, specialty, and technical oils; petrolatums and waxes; aviation and motor gasoline stocks; kerosene; diesel and heating oils; chemicals and petrochemicals.



HAVE CATALYST OR CATALYST CARRIER NEEDS?

Our sorptive minerals are recognized standards in desulfurization, reforming and isomerization systems—catalytic removal of unsaturates—conversion of sulfides to elemental sulfur—fluid catalyst applications—as catalyst carrier in copper sweetening processes.

WHAT DO YOU WANT TO DRY?

We offer a wide range of reliable, thoroughly proved desiccants for drying air, hydrogen, carbon dioxide, hydrocarbon liquids and gases.

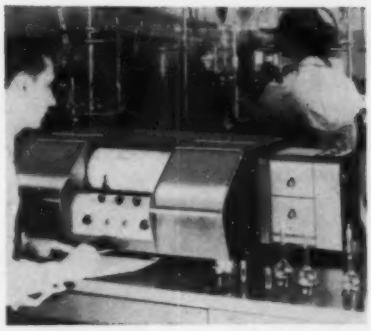
SPECIAL GRADES

Mine and plant facilities permit prompt and economical production of grades meeting individual customer specifications. Our laboratories and technical staffs are ready to assist in research, development, design and operating problems. Your inquiries are invited.

ATTAPULGUS DIVISION
Minerals & Chemicals Corporation of America

POROCEL
Corporation

DEPT. D, 210 WEST WASHINGTON SQUARE, PHILADELPHIA 5, PA.



Recording Spectrophotometer Test Cycle Is under 2½ mins.

. . . permitting samples to be checked at the rate of 170 in less than an 8-hr. day. Automatically scanning and recording the entire visible or ultra-violet spectrum in less than one minute, the new "Warren Spectracord" is said to be about 30 to 40 times faster than contemporary instruments in its own price field, and about 10 times faster than high-precision instruments in the twice-the-price field. It uses a Beckman DU spectrophotometer as a monochromator, and will handle flame spectra, gas-discharge, and fluorescence. Transmittance scale is visible at all times on the control panel and a pointer shows pen position. Wavelength setting and slit adjustment of the monochromator appear through windows. Normal operation is in two ranges: the visible spectrum from 350 to 750 millimicrons, or the ultra-violet from 215 to 375 mu. It can be adjusted to other ranges, with or without expansion, between 200 and 750 mu. Preprinted graph paper (11 x 7 in.) which shows each wavelength exactly is available for either range. The Spectracord is line-operated from 117 (± 10%) volt, 60 cycle A.C., using 250 watts. Photometering accuracy is 0.5% of full scale; precision, better than 0.2%. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pennsylvania.

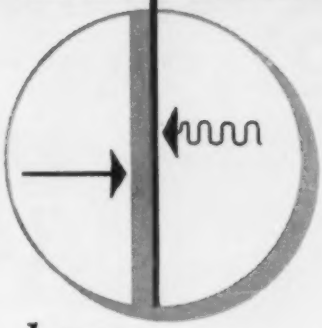
Circle No. **14** *on Reply Card*

Gas Oil Distillation Heater Has Low Wattage, Long Life

. . . because of high rate of heat transfer. The new "Lo-Cap" unit is said to be ideal for ASTM D 158, gas oil distillation, although rated at only 750 watts, instead of the 1000 watts formerly required. It is said to perform equally well on such other ASTM petroleum distillation methods as D 86, D 216, and D 850. The low mass of the new heater pro-

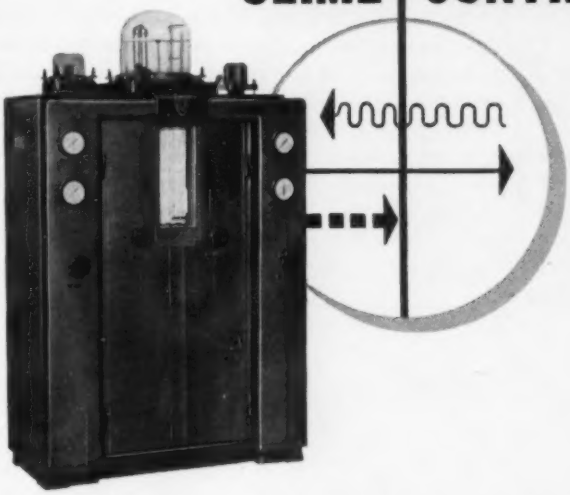
Where you need

HEAT | EXCHANGE



Be sure you have

SLIME | CONTROL



Whether you heat or cool water for make-up, process or any other use, you will need Wallace & Tiernan Chlorination to help combat slime problems introduced by water-borne bacteria or air-borne bacteria.

With slime control equipment designed for any need, built for lasting and dependable service, highly accurate and backed by over 40 years of successful application experience, Wallace & Tiernan Chlorination can help you increase the efficiency of your plant and cut operating costs. For further information write our Industrial Division.

WALLACE & TIERNAN

25 MAIN ST., BELLEVILLE 9, N. J.

CHLORINATORS • CHEMICAL FEEDERS • SCREENING EQUIPMENT • MAGNETIC SEPARATORS • PRECISION PRESSURE INSTRUMENTS • CATHODIC PROTECTION • FINE CHEMICALS

CD-39

(To obtain more data on advertised products see page 1260)

Safest Way

to get the right finish for every petroleum industry job

SPECIFY S-W

STEEL

ALUMINUM

ASPHALT

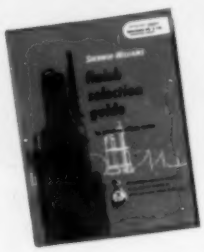
GALVANIZED IRON

WOOD

CONCRETE

Broad petroleum-industry painting requirements demand broad paint-industry technical research and experience.

That's why Sherwin-Williams, with the most extensive technical facilities in the paint industry, can offer competent help on any and all of the varied painting requirements of petroleum operations. You'll find helpful petroleum industry experience available from your Sherwin-Williams Petroleum Sales Representative . . . useful painting recommendations in the new Sherwin-Williams Petroleum Finish Selection Guide B-770. Write for your copy. The Sherwin-Williams Co., Petroleum Division, Cleveland 1, Ohio.



COVER THE EARTH

SHERWIN-WILLIAMS

PETROLEUM FINISHES

vides rapid heating and cooling, and permits distillations to follow each other more rapidly with little waiting or air-stream cooling between tests. The low mass also minimizes residual heat and reduces temperature overshoot. Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Circle No. **15** *on Reply Card*

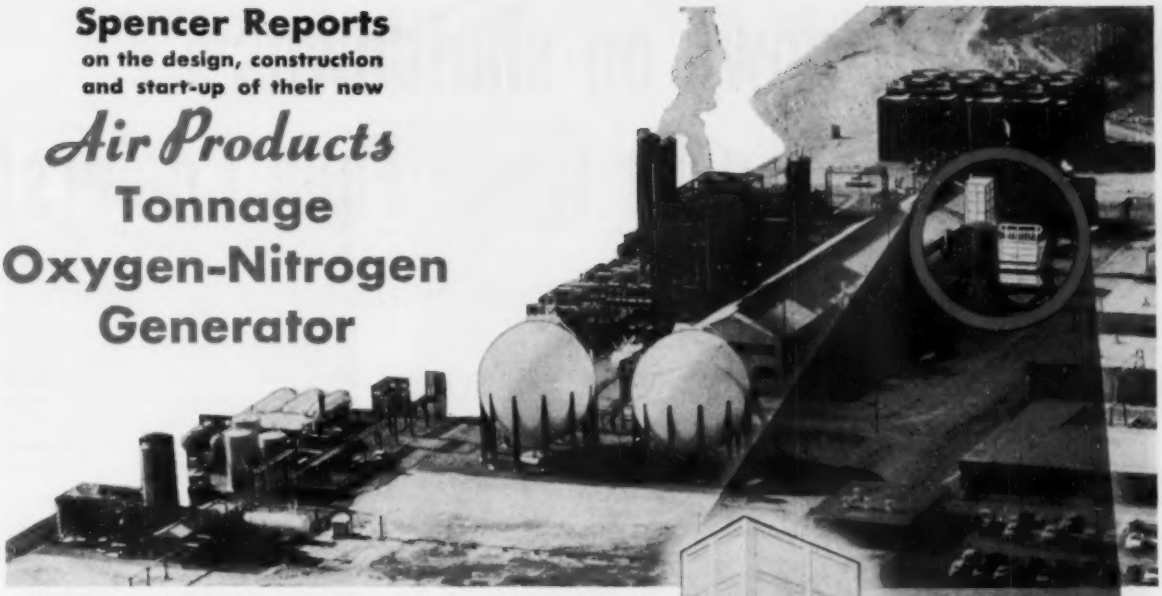
Push-Button Multiple Component Analyses Are Now a Reality

. . . in new infrared unit developed in conjunction with Ethyl Corp. To be installed in Ethyl's laboratories at Baton Rouge, La., the device will analyze automatically up to 10 components in a sample in 10 minutes. Results are presented instantly on an electric typewriter, or a counter, or a punch-card device. Instrument time is said to be shorter by nearly 50% over usual manual spectrometer analyses and chances for human error greatly reduced. Use of the new unit is expected to be primarily by petroleum and petrochemical companies, although it is applicable wherever there is a need for conducting large numbers of routine analyses of more than one component in a mixture. The instrument consists of a standard single-beam infrared spectrometer. It is attached to a control unit which sequences through ten predetermined analytical wavelengths, their selection depending upon the components to be analyzed. The sample cell is automatically shifted into and out of the infrared beam to give quantitative readings. Cycle time is 10 minutes. Photometric accuracy in the 15 to 35% transmission range is ±0.002 absorbancy units; in the 35 to 60% range, ±0.001. Quantitative analyses have been made with an average error of less than 0.1% absolute and a rela-

Spencer Reports

on the design, construction and start-up of their new

Air Products Tonnage Oxygen-Nitrogen Generator



• Spencer Chemical Company's New Ammonia Plant at Vicksburg, Miss.

Spencer Chemical Company
DWIGHT BUILDING
Kansas City, 5, Missouri

Mr. Leonard Pool, President
Air Products, Incorporated
P. O. Box 538
Allentown, Pennsylvania

Dear Mr. Pool:

"...I want to express for the entire Spencer Company our appreciation for the strong team of technical men that you have sent down to assist with the erection of the Air Plant and put it through its initial paces. They are not only technical experts, but have exhibited a fine attitude towards working together with our men."

"...It is particularly gratifying to us to see that the expanders and liquid oxygen pumps are both performing excellently."

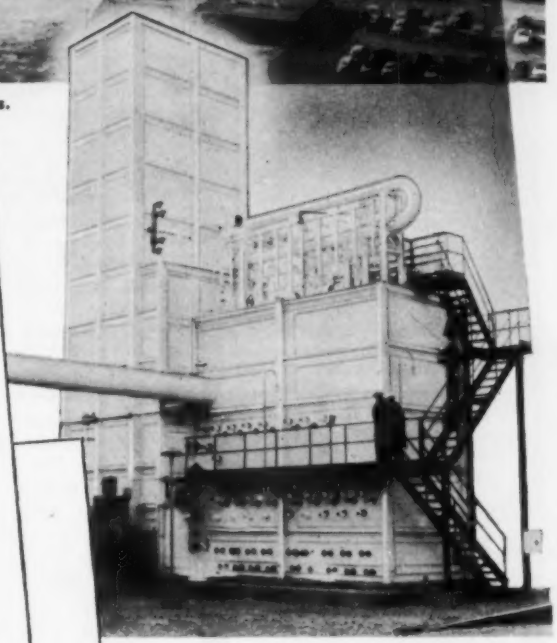
Very truly yours,

R. F. Brown
General Works Manager

"...I should like again to compliment you and your organization on the fine manner in which you cooperated with all of our Spencer people during the construction and start-up of the Vicksburg Unit. To my knowledge, it was a relationship which left little or nothing to be desired."

Very truly yours,

B. M. Kern
Chief Engineer



For this kind of service from inquiry to start-up . . . and on through the years of operation . . . entrust your low-temperature processing work to *Air Products*. If your project calls for a tonnage or high-purity oxygen and/or nitrogen generator . . . large or small hydrogen purification plant . . . a plant for separation of coke oven gas, refinery fluids . . . call us in. We can provide cost data, process design, apparatus design and manufacture . . . whatever you require. *Air Products, Incorporated, Dept. L, Box 538, Allentown, Pa.*

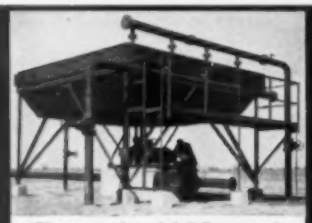
Send for 36-page brochure, "Low-Temperature Processing"

Air Products INCORPORATED

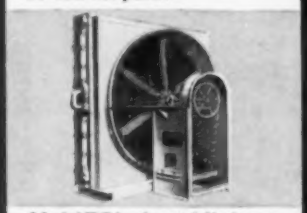
Specialists in Low-Temperature Processing

Now! Cut down on shutdowns with Trane Fluid Coolers!

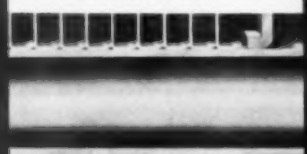
Lick vibration failure...reduce maintenance three ways



Close-up of model GC vertical discharge TRANE Fluid Cooler at Sun Oil plant.



Model EC horizontal discharge TRANE Fluid Cooler.



Fin-to-tube mechanical bond is as permanent as the metals that form it.

Downtime can be turned into operating time when you install TRANE Fluid Coolers, used by nation's leading oil and gas companies because they last longer, need less maintenance. Here's why...

Design protects coil from all vibration ... Motor and balanced fan mounted *independently* of rest of unit. Fin and tube mechanically bonded for life. No solder to loosen—no thin radiator tank. Header *floats* in casing to reduce stress on tube-to-header rolled joint.

Maintenance downtime cut three ways ... **1.** Removable header plate lets you get at tubes quickly. Round tubes easier to rod out. **2.** Single tube can be relined or plugged without removing entire core section. **3.** Plate type fins stay cleaner longer, are easier to clean.

No extra bracing needed ... Rugged steel framework engineered to withstand wind and earth shock. Field assembly is simplified. Cooler operates as designed ... the *first* time—*all* the time.

Automatic controls save power ...Two-speed motor and automatic shutters over coil permit close control for maximum power savings.

Get all the facts today ... Call your TRANE Sales Office or write TRANE, La Crosse, Wis., for Bulletin DS-395 containing capacities, performance curves, construction details, roughing-in dimensions, installation data and specifications.

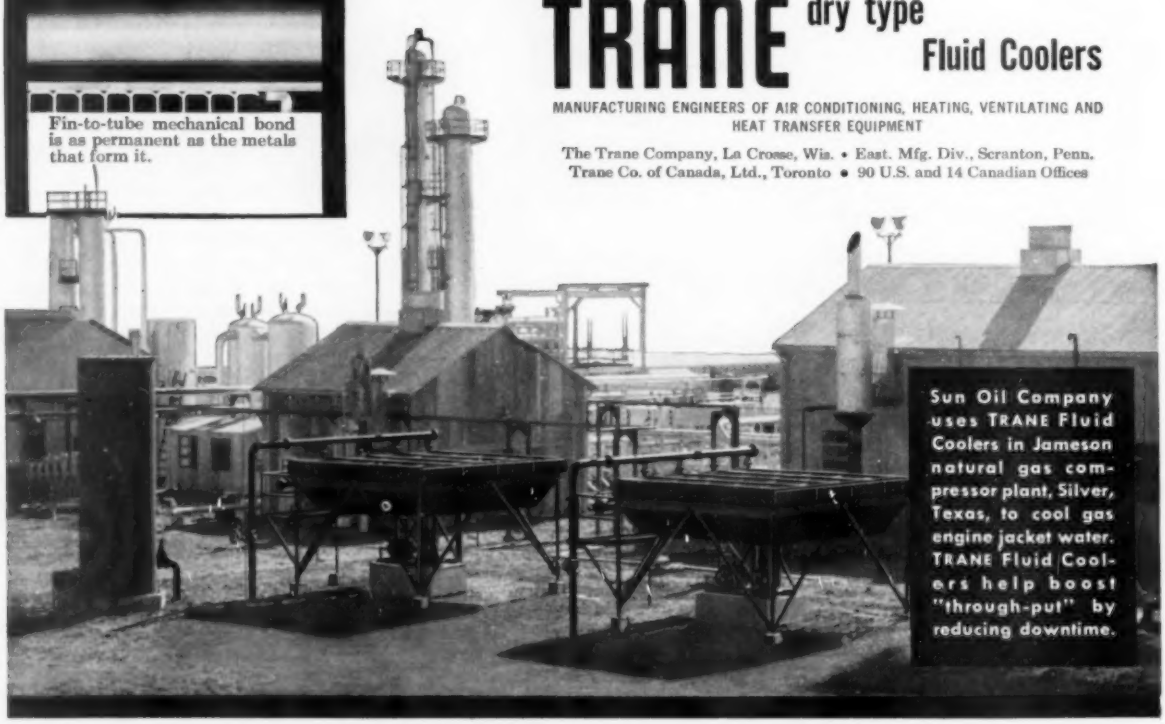
Typical users include Atlantic Refining Co.; Cooper Bessemer Corp.; Nordberg Mfg. Co.; Shell Oil Co., Refinery Division; Wolverine Pipe Line Co.

For lower operating cost ... less downtime ... specify

TRANE dry type Fluid Coolers

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

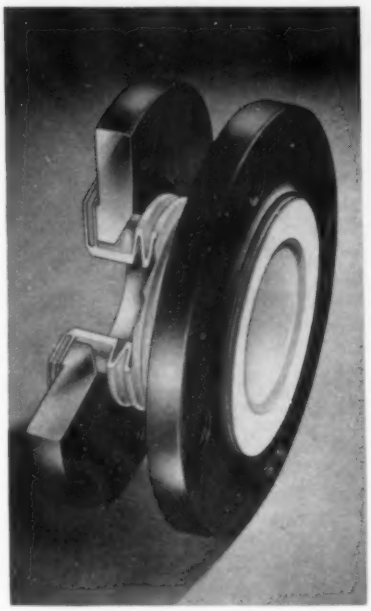
The Trane Company, La Crosse, Wis. • East. Mfg. Div., Scranton, Penn.
Trane Co. of Canada, Ltd., Toronto • 90 U.S. and 14 Canadian Offices



Sun Oil Company uses TRANE Fluid Coolers in Jameson natural gas compressor plant, Silver, Texas, to cool gas engine jacket water. TRANE Fluid Coolers help boost "through-put" by reducing downtime.

tive error of less than 0.02% of the amount present. The Perkin-Elmer Corp, Norwalk, Conn.

Circle No. **16** *on Reply Card*



Teflon Bellows Have Companion Flanges Conforming to Standards

. . . for bolt hole circles (ASA), and numbers for pressures up to 125 psi. They can be supplied to fit any pipe size from ½ through 12 in. The bellows feature a new convolution form which is said to give greater strength, longer life, and increased flexibility. They expand and contract in either direction with equal freedom of motion. Operating temperature range is from —94 to +500° F. Flanges are of the French-type gasket construction to provide more efficient sealing at lower flange pressure. Casket insert material is asbestos or synthetic rubber. Crane Packing Co., Dept., PPN, 1800 Cuyler Ave., Chicago 13, Ill.

Circle No. **17** *on Reply Card*

Trade Literature

Acrylonitrile Conversion Chart

. . . showing chemical methods for synthesizing more than 100 derivatives from acrylonitrile; wall chart, 44x34 in., has methods classified according to three main types of reactions: cyanoethylation, nitrile, and olefinic. Monsanto Chemical Co., St. Louis 4, Mo.

Circle No. **18** *on Reply Card*

for dependable, trouble-free control
"of hard-to-hold" fluids . . . . .

SPECIFY
HOMESTEAD
Lever-Seald
VALVES

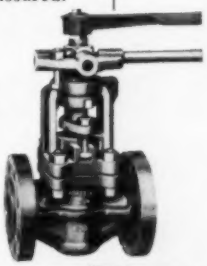
they provide sure shut-off . . .

ARE STICK PROOF . . . OPERATE INSTANTLY

A positive, drop-tight seal and instant, stick-proof operation under all fluid, temperature or pressure conditions, is assured by the exclusive, built-in, Homestead Lever-Seald mechanism. This powerful lever-and-screw device not only presses the valve's tapered plug firmly into its seat to form a drop-tight seal, but also provides a positive means of relieving seating pressure just enough to overcome friction and permit easy operation. And because all operating parts and valve seating surfaces are fully protected in both the open and closed positions from the corrosive or erosive effects of line fluids, long, dependable, trouble-free service is doubly assured.

If "hard-to-handle" fluids are your problem, specify Homestead Lever-Seald Valves for your next installation or as replacements. You'll be glad you did.

We make them in metals and alloys to specification in sizes 1½" to 12", for pressures from vacuum to 1500 lbs., and for temperatures from 40° below zero to 1100°F. Dry seat, or pressure gun lubricated optional.



For complete details and copy of VALVE REFERENCE BOOK No. 39-3, MAIL THE COUPON TODAY.

Without obligation, send me Catalog 39-3 covering Homestead Lever-Seald Valves.

NAME_____

COMPANY_____ TITLE_____

ADDRESS_____

CITY_____ STATE_____

HOMESTEAD VALVE MANUFACTURING COMPANY
Serving Since 1892

P. O. Box 43 Coraopolis, Pa.

For Trouble-Free Pipe Threading ...its a 65R RIDGID

This 65R threads 1" to 2" pipe with 1 set of dies ...and it won't jam!

You won't find a die stock to equal this popular 65R—anywhere! It saves time—one set of self-contained high-speed dies adjust to 1", 1¼", 1½" or 2" pipe or conduit in 10 seconds! Mistake-proof self-centering workholder sets to size instantly! It saves trouble—lead screw won't jam, it kicks out automatically when standard length thread is cut. Clean perfect threads, *fast!* For trouble-free extra-easy pipe threading buy 65R at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

RIDGID
Work-Saver Pipe Tools

What's New!

Pressure Vessel Code

. . . is covered in a 28-page booklet, *The ASME Pressure Vessel Code—A Joint Effort for Safe Construction.* written by Elmer O. Bergman, staff consultant for C. F. Braun & Co., Alhambra, Calif. Address requests to the Publications Dept. of C. F. Braun.

Do Not Use Reply Card

Tubing for Condensers

. . . and heat exchangers, of "Electrunite," in carbon and stainless steels; *Booklets HES-1* and *HEC-1* contain full engineering information, applications, etc. Republic Steel Corp., Steel and Tubes Div., Cleveland 8, Ohio.

Circle No. **19** *on Reply Card*

Quick Set Thermoregulator

. . . with a sensitivity of 0.02° F. and range from room temperature to 550° F.; described in *Catalog No. 15,* single-page leaflet of specifications. Philadelphia Scientific Glass Co., Abington, Penna.

Circle No. **20** *on Reply Card*

Scale Models

. . . of any product, prototype design, or piece of equipment, made in metal, wood, or plastic; *Booklet "K"* illustrates a number of models produced by the company, cites applications for models. Arthur B. Johnson & Co., 392 E. 201 St., New York 58, N. Y.

Circle No. **21** *on Reply Card*

Lubricated Plug Valves

. . . in full-port and Venturi types, sizes up to 14 in.; *Reference Book 39-5* contains dimensions of parts, types of control, metals, accessories, pictures of typical installations; supplement, *Section 5A,* lists lubricants suitable with different fluids. Homestead Valve Manufacturing Co., Coraopolis, Pa.

Circle No. **22** *on Reply Card*

Acetonitrile Data

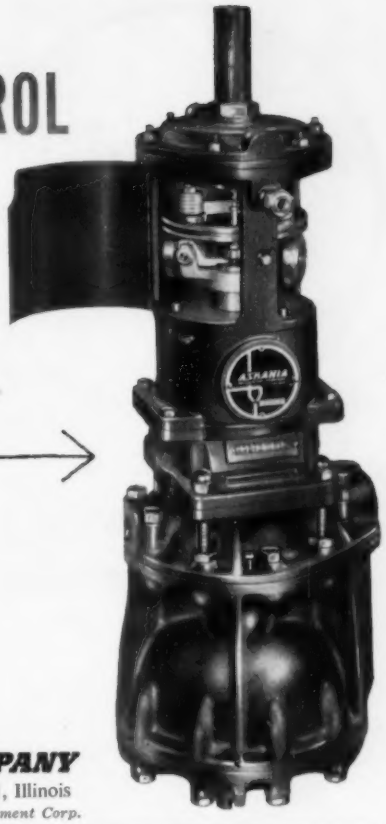
. . . are compiled in eight-page technical bulletin, *F-7501;* included is information on its properties, constant-boiling mixtures, solubility for diverse materials, uses, suggested applications, and a bibliography. Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.

Circle No. **23** *on Reply Card*

(To obtain more data on advertised products see page 1260)

FOR MEASUREMENT and CONTROL of VISCOUS FLUID FLOW...

the ASKANIA TRANSOMETER



Designed for fuel oil and other viscous liquids, the Askania Transometer accurately measures flow and transmits a corresponding pneumatic signal.

This signal can be in the range of inches w. c., to match equivalent gas flow measurement; or in the standard instrument transmitter range of 3-15 p.s.i.

Sturdy Askania construction, over-range protection, built-in integrator, wide range. Write for Bulletin 125.

ASKANIA REGULATOR COMPANY
244 E. Ontario Street, Chicago 11, Illinois
Subsidiary of General Precision Equipment Corp.

COMING — *NEXT MONTH*

YOUR ANNUAL ROUND-UP OF

THE PETROCHEMICAL INDUSTRY

Its Status Today—
Its Future Potential—

YOUR 1954 PETROCHEMICAL PLANT SURVEY

THE OUTLOOK FOR ALL PETROCHEMICALS

THE OUTLOOK FOR END PRODUCTS

★ *Synthetic Detergents*
★ *Plastics*
★ *Carbon Black*
★ *Synthetic Rubber*
★ *Fertilizers*
★ *Sulfur*
★ *Pesticides*
★ *—and many more*

Watch For It — Next Month

PETROLEUM PROCESSING
NOW A McGRAW-HILL PUBLICATION
330 West 42nd Street, New York 36, N. Y.

Registered Professional Engineer In Wisconsin | Serving Industry Since 1947 | We Maintain A Well Equipped Laboratory

OUR SPECIALTY

SPONSORED RESEARCH

Backed by forty years experience as research chemist, group leader and research director in the organic chemical industry.

Five of our ninety-four clients account for fifty percent of our business. We handle all of their research and development work on a two year contract basis.

Put *YOUR* research man in *OUR* laboratory under experienced supervision.

We are equipped and experienced for the routine testing of *PETROLEUM PRODUCTS*. We invite correspondence relative to our taking on research and development problems from one small but growing unit in the *PETROLEUM INDUSTRY*.

Only one representative of an industry accepted.

Visit us, look us over and discuss the possibilities with us.

W. J. COTTON LABORATORIES
3530 WEST FAIRMOUNT AVENUE
MILWAUKEE 9, WISCONSIN
PHONE: Hilltop 2-3405

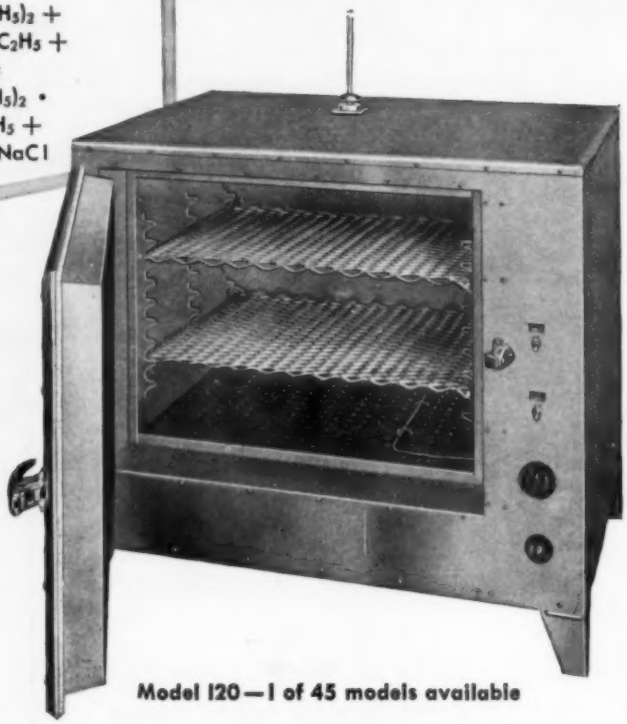
CONSULTING CHEMISTS & CHEMICAL ENGINEERS

beyond question-

like a proved formula

$CH_2(COOC_2H_5)_2 + ClCH_2COOC_2H_5 + C_2H_5ONa = CH(COOC_2H_5)_2 \cdot CH_2COOC_2H_5 + C_2H_5OH + NaCl$

Precision **FREAS***



Model 120—1 of 45 models available

For more than 40 years laboratory people have been justified in relying on Freas. During many of these years we were unable to produce Freas units as fast as they were called for. Now, after notable expansion, we can ship most models from stock. Freas *quality,* far from being compromised, has actually been improved.

***Ask your laboratory supply dealer about Freas ovens, incubators or sterilizers.*

Write for CATALOG 331A

Precision Scientific Company

3737 West Cortland Street Chicago 47

Specify FREAS First . . . . to Last

What's New!

The Ethanolamines

. . . mono, di, and triethanolamine; booklet gives properties, chemical performance, and pH values of the three compounds; contains vapor-liquid composition curves, as well as viscosities and total vapor pressures of solutions; lists properties of ethanolamine soaps; reviews uses of the compounds. Dow Chemical Co., 45 Rockefeller Plaza, New York City.

Circle No. **24** *on Reply Card*

Controlled Volume Pumps

. . . in petroleum processing; three applications are described by company: cooling tower pH control, in data sheet *E-54-2;* corrosion control in process towers and equipment, in data sheet *E-54-3;* and the desaponification of crude oil, in data sheet *E-54-4.* Milton Roy Co., 1300 E. Mermaid Lane, Philadelphia 18, Pa.

Circle No. **25** *on Reply Card*

Centrifugal Pumps

. . . saddle mounted, vertically split, for boiler circulation and heater drain service; *Bulletin W-341-B11B* describes construction materials, coverages available, pressure-temperature limitations, and gives cross-section drawings of the types of pumps, together with dimensions and specifications. Advertising and Sales Promotion Dept., Worthington Corp., Harrison, N. J.

Circle No. **26** *on Reply Card*

Steam Flow Control System

. . . utilizing a selector device to regulate pressure and flow within preset limits and thus to avoid pressure build-ups from clogged trays; *AED 282-6* describes the system, its advantages and component parts, and includes diagrams of its operation. The Foxboro Co., Foxboro, Mass.

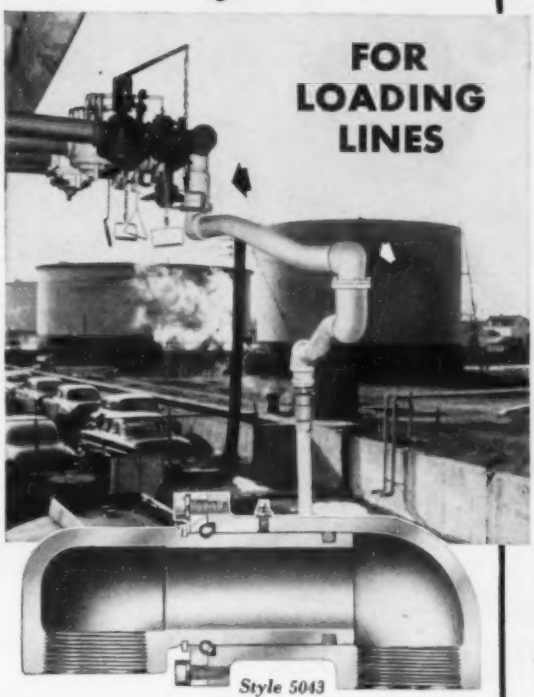
Circle No. **27** *on Reply Card*

Styrene Monomer

. . . a coal-derived chemical product basic to a variety of other products; *Bulletin C-4-198* gives its specifications, derivatives and their commercial use; *Bulletin C-4-119* offers detailed technical information, such as chemical reactions, methods of handling, and analysis. Chemical Division, Koppers Co., Inc., Koppers Bldg., Pittsburgh 19, Pa.

Circle No. **28** *on Reply Card*

BARCO Swing Joints



Style 5043

Style 5041
Style 5047
Style 5042
Style 5049
Style 5040
Style 5044
Style 5045
Style 5048
Style 5050
Style 5046

HERE is why users like BARCO'S new *all-steel* Swing Joints for loading and unloading gasoline, oil, lube oil, LP gas, petro-chemicals and other fluids:

BALL BEARING AND O-RING EQUIPPED—In Barco Swing Joints, the ball bearings do not fall out when joints are taken apart! Long bearing provides adequate pipe support. *Special O-ring seal eliminates frequent gasket replacement.* Seals on pressure or vacuum. Leakproof service over wide temperature range, −40°F. to 225°F.

LONG LIFE—New *"Bar-Moly"* dry lubricant process gives a permanent anti-galling, corrosive-resistant finish to moving parts. This, combined with routine lubrication, insures longest possible maintenance-free service.

EASY MAINTENANCE—Joints can be disassembled for inspection without disconnecting piping. O-rings are easily renewable in the field. Frequent greasing not required to maintain sealing.

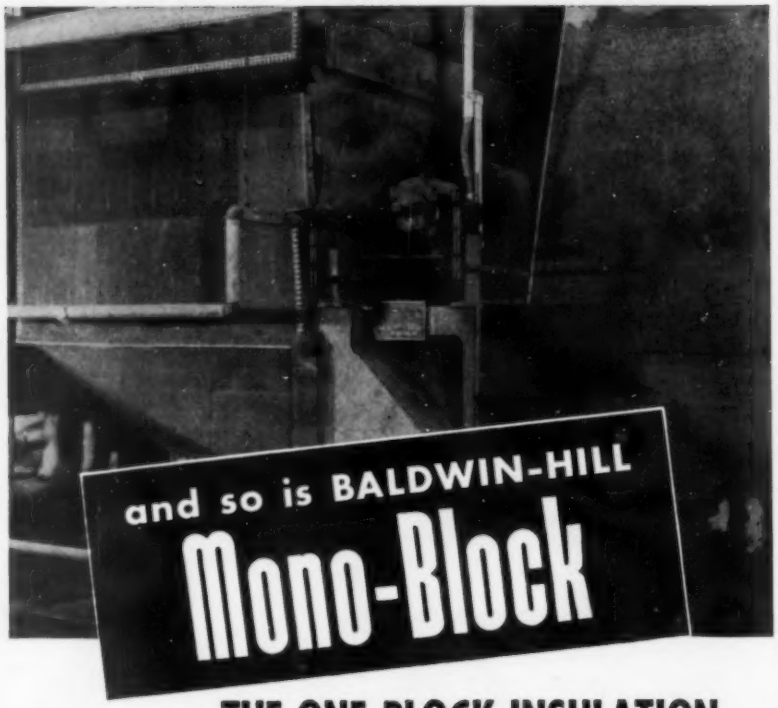
MANY STYLES—The Barco line is complete with single swing, double swing, and counter-balance styles to meet every need. Sizes 2", 2½", 3", 4".

BARCO MANUFACTURING CO.
5591 HOUGH STREET
Barrington, Illinois
Worldwide Sales and Service

For complete information on Barco Swing Joints, ask for a copy of Catalog 400.

(To obtain more data on advertised products see page 1260)

PETROLEUM PROCESSING is a problem solver



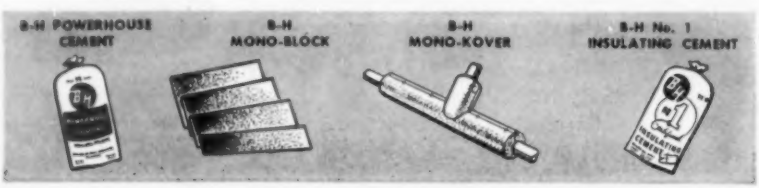
BALDWIN-HILL BH INSULATIONS

THE ONE-BLOCK INSULATION FOR TEMPERATURES UP TO 1700°F

- One Block application instead of two.
- Light in weight, easily cut with a knife to fit odd shapes.
- Impales over studs, clips, or wires.
- Low thermal conductivity because of unique felted structure.
- Forms strong bond with insulating cements.

Baldwin-Hill COMPANY
1608 BREUNIG AVE., TRENTON, N. J.
Kalamazoo, Mich. • Huntington, Ind. • Temple, Tex.

Send for bulletin with data on composition, properties, efficiency and low applied cost.



What's New!

Piping Stress Handbook

. . . offering a simplified solution to frequently encountered problems in refinery and petrochemical plant design; a 50-page book, *Thermal Stresses in Piping Systems* was written by William E. Wilbur, principal designer for Fluor Corp. Offered as a limited edition. Address requests direct to The Fluor Corp., Ltd., Los Angeles, Calif.

Do Not Use Reply Card

Aluminum Welding

. . . and the latest developments in this field are fully covered in a new 176-page book, *Welding Alcoa Aluminum*, designed as a text and a practical manual; including data on selection of method, performance of welds, control of welding quality; and 32 comprehensive tables of data on properties of alloys, compositions, and strengths. Copies are available from Aluminum Co. of America, 733 Alcoa Bldg., Pittsburgh 19, Penna.

Circle No. **29** *on Reply Card*

Pumping Volatile Liquids

. . . by means of the vapor pump; a four-page reprint of a technical article on transfer units for LPG and similar fluids. Worthington Corp., Harrison, N. J.

Circle No. **30** *on Reply Card*

Separation Equipment

. . . for low-temperature operation; three pamphlets cover company's "Cold-Frac" line: *Catalog 33-01* describes operation of model without hydrate inhibitor, *Catalog 33-01A* shows how to make an application of low-temperature separation procedures to small gas-condensate wells, and *Catalog 33-02* contains full details on equipment carrying hydrate inhibitor. Black, Sivalls & Bryson, Inc., 7500 E. 12th St., Kansas City 26, Mo.

Circle No. **31** *on Reply Card*

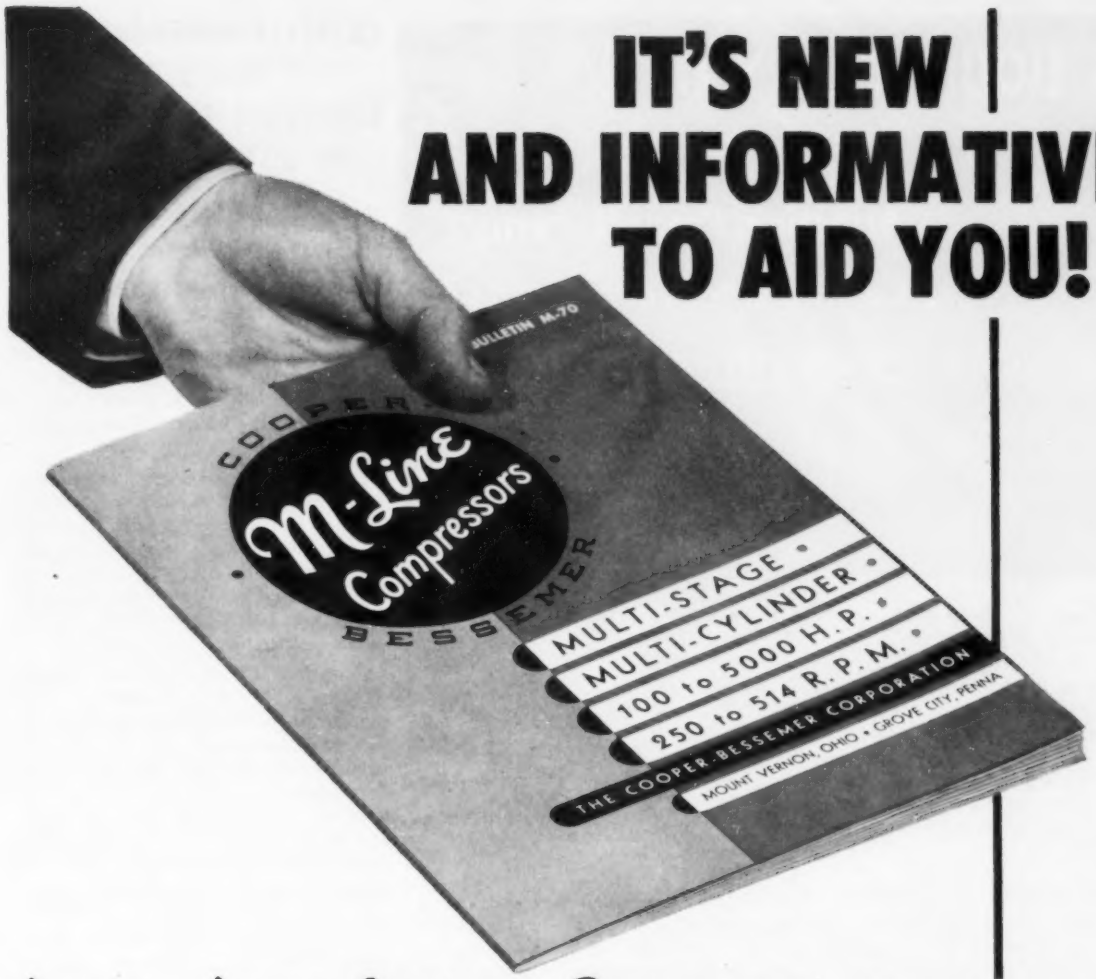
Solenoid Valves

. . . operated by synthetic rubber diaphragms, in six sizes ranging from ⅜ in. to 1½ in.; *Bulletin M-500* has cross-section views showing open and closed positions and drawings giving over-all dimensions; specifications are given for gas-air valves (low, medium and high-pressure), water valves and oil valves. Eclipse Fuel Engineering Co., 1012 Buchanan St., Rockford, Ill.

Circle No. **32** *on Reply Card*

(To obtain more data on advertised products see page 1260)

IT'S NEW AND INFORMATIVE TO AID YOU!



Learn how Cooper-Bessemer compressors can cut your costs!

THE new Cooper-Bessemer M-Line Bulletin offers you complete information on economically meeting compressor requirements from 100 to 5000 horsepower. This interesting 44-page booklet simply and fully explains how and why Cooper-Bessemer compressors assure you maximum trouble-free performance at minimum operating expense.

Additional bulletin features include complete data on design, lubrication, automatic controls, cylinders, motor and drives, specifications and photographs of various compressor installations. Cooper-Bessemers offer you new, unusual plus features that are paying off in job after job. To find out about them, send for your M-Line Bulletin today.

MOUNT VERNON, OHIO
COOPER-BESSEMER
GROVE CITY, PENNA.

New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.

THE COOPER-BESSEMER CORPORATION 8
Mount Vernon, Ohio

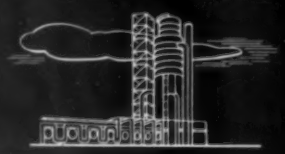
Please send me Bulletin M-70 on Cooper-Bessemer M-Line Compressors.

Name ..... Title .....
Company .....
Street Address .....
City ..... Zone ..... State .....

IS LIQUID CARRY OVER–

. . . Limiting Your Production?
. . . Affecting Product Purity?
. . . Cutting Into Your Profits?

IF SO–GET THE FACTS ON METEX MIST ELIMINATORS!



Section of a METEX MIST ELIMINATOR, opened to show construction. They can be made of practically any metal, to combat corrosion. Factory cut to fit vessel dimensions and contour, there is no limit to the size in which they can be obtained.

Liquid entrainment need no longer be considered an unavoidable nuisance in processing operations, as more and more engineers are finding from experience. These *knitted* wire mesh entrainment separators literally "filter out" the entrainment (see diagram) and permit the gas to pass on, freed from the unwanted—and often contaminating—liquid.

METEX MIST ELIMINATORS can be easily installed in new or existing vessels. They require no special housings, equipment or power—and need no servicing or attention. They function over a wide range of velocities with a pressure drop usually so low it cannot be measured. Users report efficiencies of 99% and more.

METEX Mist Eliminators can be used wherever the problem of liquid entrainment exists. By effecting complete removal of liquids, Mist Eliminators contribute to more efficient and economical processing in such vessels as:

- VACUUM PIPE STILLS
- FRACTIONATING TOWERS
- KNOCK-OUT DRUMS
- EVAPORATORS
- ABSORBERS
- SCRUBBERS
- COMPRESSORS
- SEPARATORS
- STEAM DRUMS

Write TODAY for free catalog giving complete information and engineering data. Or tell us about your SPECIFIC *entrainment problem.*

When a gas is generated in or passes through a liquid (1), it carries with it on leaving the surface (2), droplets of entrained liquid. These droplets are carried upward by the rising gas stream (3). As the gas continually changes direction in passing through the pad, the droplets are impinged on the extensive wire surface. Here the droplets coalesce, forming large drops of liquid which break away (4) from the pad and fall back through the gas stream. The gas (5) passes on, freed from liquid entrainment.

METAL TEXTILE CORPORATION

KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY

METEX

Roselle, New Jersey

CATALYST CONTAMINATION CURED BY REMOVING ENTRAINMENT IN DISTILLATION UNIT

Equipment Costing $15,000 Pays Out In Under A Week For Large Southwestern Refinery

It was not a difficult problem to trace the cause of mounting catalyst losses to a cat unit feed so poor in color that it was essentially black. Entrainment of liquid from the bottom of the still column could be the only answer.

Here was a situation where a Metex Mist Eliminator would remove the entrainment — but what else might happen? Would this knitted wire mesh separator cause excessive pressure drop? How quickly would it become plugged by coke deposits and make the column inoperable?

Calculations by one engineer showed that the total cost of installing a 25-ft diameter Mist Eliminator, including designing and erecting supports within the still, was approximately $15.000 — less than a week's catalyst loss. After considerable study the decision was made, and the Mist Eliminator installed during the next routine turnaround.

When the first run of cat unit feed came from the remodeled crude distillation unit, it was crystal clear and water white. Throughout the normal run no differential pressure across the screen was found.

The problem was solved. Catalyst losses dropped sharply. And the Mist Eliminator has paid for itself in a matter of days.

Have you really analyzed your entrainment costs, and checked the savings a Mist Eliminator could make for you? Perhaps you are losing valuable end products in the exhaust stream. Perhaps you have a nuisance contamination problem. Perhaps the entrainment created in one vessel is causing trouble in a subsequent operation. For entrainment is an inevitable result of most processing and refining operations.

Metex Mist Eliminators perform just one function—and they are doing it in more and more refining vessels every day. They remove liquid entrainment—efficiently and economically—wherever it may occur.

Why not write today for more information on Metex Mist Eliminators. Or better yet, send data on your particular entrainment problem. We'll be glad to have our engineers check this, and send you our recommendations and suggestions.

What's New!

Pipe Markers

. . . for identifying process load, said to be adhesive on pipes having continuous temperatures up to 300° F., or intermittent temperatures to 450° F.; *Bulletin 135-B* shows company's three basic printing styles and lists marker legends in stock. W. H. Brady Co., 727 W. Glendale Ave., Milwaukee 12, Wis.

Circle No. **33** *on Reply Card*

Compressor Unit

. . . type "GMVA," a redesigned engine-driven machine giving 540 to 1350 hp. at 300 rpm., with four, six, eight or 10 cylinders; *Bulletin 75* gives design features, general specifications, and detailed cross-sections of the entire unit and the cylinders. Cooper-Bessemer Corp., Mt. Vernon, Ohio.

Circle No. **34** *on Reply Card*

High-pressure Solenoid Valves

. . . direct lift and pilot-operated types, for service to 5000 psi.; *Bulletin HP* 201 gives pressure ranges for types and sizes of valve, a nomenclature diagram and schematic plan of operation. Atkomatic Valve Co., Dept. H-238, 545 Abbott St., Indianapolis 25, Ind.

Circle No. **35** *on Reply Card*

CLASSIFIED

MANAGER OF REFINING

FOR PROGRESSIVE INTEGRATED OIL COMPANY

Outstanding opportunity for qualified man to handle operations of moderate sized refinery. Supervisory experience and acquaintance with modern processing including catalytic cracking, light hydrocarbon processing, coking, refinery maintenance and economics desirable. Preferred age 35 to 45. The company is a long established one in an agreeable U. S. location. Position offers excellent immediate and long-term prospects.

All replies will be held in confidence. Please give pertinent details of education and experience in your first letter.

P3317 Petroleum Processing

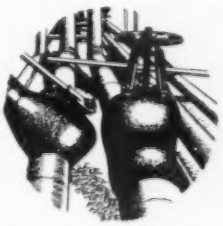
330 W. 42 St., New York 36, N. Y.

Laykold®
ASPHALT SPECIALTIES

WEATHERCOAT
Slows Weathering

WEATHER and WATER can't affect the protective qualities of Weathercoat: this tough ductile asphaltic coating *bridges* expansion, but remains firm under heat or cold.

That's why Weathercoat is preferred by most of the world's largest refineries* for protection of exposed insulation on fractionating columns, crude stills and tanks . . . for sealing insulation joints . . . exposed insulated pipelines . . . for membranes in reservoirs.



No fire hazard—apply it cold!
Brush, trowel or spray Weathercoat —it's easy—"palms" beautifully over uneven surfaces!

**Names on Request*

AMERICAN
Bitumuls & Asphalt
COMPANY

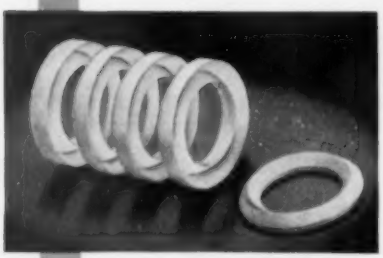
200 BUSH ST. • SAN FRANCISCO 4, CALIFORNIA

E. Providence 14, R. I. Perth Amboy, N. J. Baltimore 3, Md. Mobile, Ala. Columbus 15, Ohio
Tucson, Ariz. Seattle, Wash. Baton Rouge 2, La. St. Louis 17, Mo. Inglewood, Calif.
Oakland 1, Calif. Portland 7, Ore. Washington 6, D. C. San Juan 23, P. R.

MADE OF TEFLON
duPont Trademark

Chemiseal Packing

- won't contaminate
- won't deteriorate
- won't "freeze" shaft action



V-TYPE PACKING

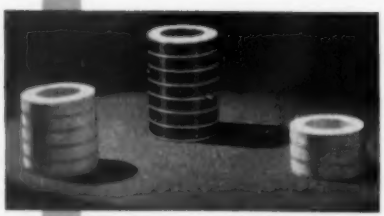
Chemiseal Type 810 TEFLON V-Packing for use in manual, air or motor operated valves. Construction and distinctive tapered V design offers chemically impervious service and greater flexibility and resiliency, providing necessary seal at low gland pressure and reduced torque on valve stem.

CUP AND CONE TYPE PACKING

Chemiseal Type 810-W TEFLON Packing for both hand and mechanically operated valves. Cones deform inwardly to effect a seal at the spindle, while cups expand outwardly against stuffing box wall, making possible a tight seal at low gland pressure.

WEDGE TYPE PACKING

Chemical Type 810-WX Packing offers the unusually low gland load required for valves made of Haveg, Karbate, ceramics, etc. Rings provide space for thermal expansion. Also adaptable for spring loading wherever exceptionally low friction load is required.



PUMP PACKING

Order Chemiseal Types 711-G, (graphite, impregnated) No. 711-M, (impregnated with mica) and No. 711-O (pure TEFLON). For general purpose or non-contaminating pump service throughout the processing industries.

▶ *Write for Catalog Number TP-1053.*

UNITED STATES GASKET COMPANY

CAMDEN 1 • NEW JERSEY

FABRICATORS OF duPont TEFLON, Kellogg KEL-F AND OTHER PLASTICS

Representatives in Principal Cities Throughout the World

What's New!

Platinum Cladding

. . . for tubes, linings of vessels, wire, anodes, etc.; 4-page bulletin describes applications and performance of cladding under different conditions. G. R. Brieche, Advertising Manager, Baker & Co., 113 Astor St., Newark 5, N. J.

Circle No. **36** *on Reply Card*

Raman Spectrometer

. . . of the recording type, designed for industrial and research laboratory application of the complete Raman technique; *Instrumentation Data Sheet No.* 10.16-8a describes Raman technique, equipment required for unit and its mode of operation, operational and design features and presents schematic diagrams of the optical and electronic system. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

Circle No. **37** *on Reply Card*

Thermal Elements

. . . of noble and base metals and porcelain; bulletin describes different material combinations, including platinum vs. platinum-rhodium, chromel vs. alumel, porcelain, lead, etc.; specifications are given for each type, and the best combinations for each application are discussed. Charles Engelhard, Inc., 850 Passaic Ave., East Newark, N. J.

Circle No. **38** *on Reply Card*

Organic Acids

. . . their uses in many industries, their physical properties, specifications, shipping data, and constant boiling mixtures; booklet, *Organic Acids,* includes acetic, butyric, caproic, crotonic and others made by the company in commercial quantities. Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.

Circle No. **39** *on Reply Card*

Low Capacity Venturi

. . . with size of inlet ranging from ½ in. to 2 in., made of cast iron, stainless steel or bronze; 5-page brochure includes information about sizes for different applications, photographic enlargements of parts before and after tube is welded, and a diagram of an installation. Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia 42, Pa.

Circle No. **40** *on Reply Card*

(*To obtain more data on advertised products see page 1260*)

GE picks waterproof, fireproof FOAMGLAS to insulate Atomic Sphere

The G. E. Atomic Sphere is 26 times larger than any previously built. It has a surface area of 159,000 sq. ft. Inset photo shows how easily the lightweight FOAMGLAS blocks were handled by the workmen. This rigid insulation was more than strong enough to support their weight, yet easy for them to cut and shape.

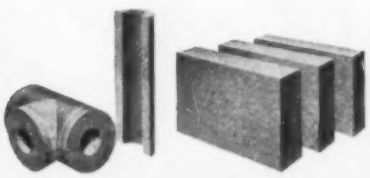
General Electric Company engineers picked waterproof, fireproof FOAMGLAS to insulate the world's largest steel sphere. The Knolls Atomic Power Laboratory, Schenectady, which G.E. operates for the A.E.C., will use the sphere to test the prototype of an atomic powered submarine for the U.S. Navy. *Constant* control of temperatures is a must for worker comfort. Therefore, to insulate the sphere FOAMGLAS was a must because its sealed glass cells can't absorb the moisture that cuts efficiency of other insulations. This guarantees GE *constant*, *long-lasting* insulating protection . . . and fireproof FOAMGLAS reduces external fire hazards which might damage the sphere.

Why not discover how FOAMGLAS can benefit *you?* Send today for a sample and your choice of booklets describing the use of FOAMGLAS to insulate: 1) piping, tanks and other equipment; 2) cold storage space; or 3) normal temperature buildings. Write, indicating your specific interest.

PITTSBURGH CORNING CORPORATION
Dept. PP-84, One Gateway Center • Pittsburgh 22, Pa.

FOAMGLAS®

the cellular, stay-dry insulation



PITTSBURGH PC CORNING®

Pittsburgh Corning also makes PC Glass Blocks

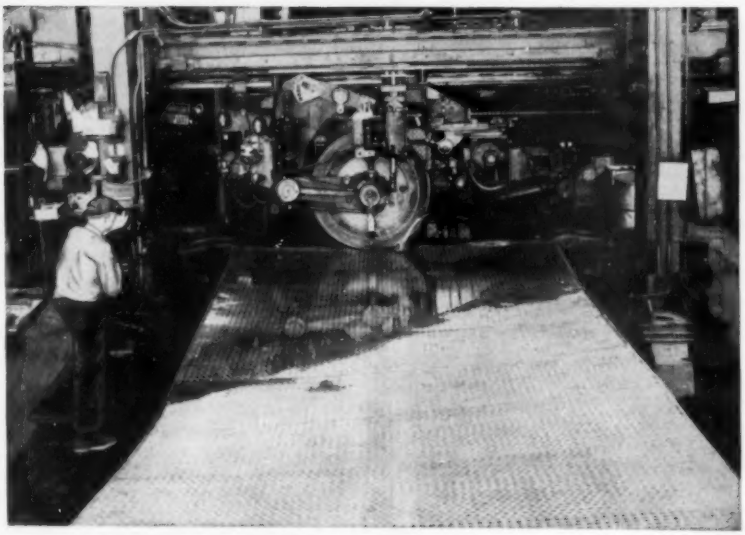
Made to Last in Severe Corrosives

A TOWER OF RESISTANCE

Strips of HASTELLOY alloy C are being arc-welded to this 44-ft. long tower to give it added corrosion resistance. The entire inside surface of the vessel is covered with ⅛-in. thick sheet.

SEALING OUT CORROSION

This lining of HASTELLOY alloy F will resist acids and alkalies. It is attached to steel by the Smithlining* spotweld process, one of the many ways of attaching HASTELLOY alloys to steel. Use of lined-sheet is an economical means of handling severe corrosives.



HASTELLOY *alloys can help solve your corrosion problems, too. For further information, contact the nearest Haynes Stellite Company office.*

*"Smithlining" distinguishes an exclusive process of the A. O. Smith Corporation, Milwaukee, Wisconsin.

HASTELLOY *alloys*
TRADE-MARK

Nickel-base, corrosion-resistant alloys available as sheet, plate, bar stock, welding rod, welded tubing and pipe, cast pipe and pipe fittings, sand and precision-investment castings.

"Hastelloy" is a registered trade-mark of Union Carbide and Carbon Corporation.

Haynes Stellite Company
A Division of
Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices
Chicago — Cleveland — Detroit — Houston
Los Angeles — New York — San Francisco — Tulsa

Motorized Valve Controls

. . . for sizes ranging from 1½ in. to 8 in. part diameters; unit has switch that will adjust torque or stem thrust for varying service conditions; bulletin *SMA*-000 depicts applications, show components and construction details. Philadelphia Gear Works, Erie Ave. and G. St., Philadelphia 34, Pa.

Circle No. **41** *on Reply Card*

Rupture Discs

. . . of precious metal for high corrosion resistance; brochure has tables with bursting pressures for platinum, gold and silver discs, one giving fabrication charges and another showing degree of resistance to corrosion from different chemicals. Baker & Co., 113 Astor St., Newark 5, N. J.

Circle No. **42** *on Reply Card*

Leak-proof Hose Couplings

. . . with a full swiveling action to prevent twisting and kinking and a quick seal construction that tightens as internal pressure increases, for any material that can be carried in a hose; bulletin gives size information for matching parts of a coupling assembly and describes possible valve modifications. Industrial Sales, Titeflex, Inc., Hendee St., Springfield 4, Mass.

Circle No. **43** *on Reply Card*

Grooved End Valves

. . . for grooved end couplings, with rising and non-rising stems; folder contains list of prices and dimensions, construction details. Lunkenheimer Co., Box 360, Cincinnati 14, Ohio.

Circle No. **44** *on Reply Card*

Engineering Services

. . . offered by firm in research, development, design and testing are described in brochure; company handles both automotive and mechanical engineering assignments. Barnes and Reinecke, Inc., 234 E. Ohio St., Chicago 11, Ill.

Circle No. **45** *on Reply Card*

Tank Cleaning

. . . with chemical solvents; folder describes company's technique, cites applications in a number of industries. Dowell Inc., P. O. Box 536, Tulsa 1, Okla.

Circle No. **46** *on Reply Card*

A pinch of this and that . . . won't do!

The world's great bakers steer away from grandma's *pinch of this and that* methods . . . it takes superior ingredients combined to exacting recipes to produce perfect results every time.

So, too, with any refractory installation . . . Plibrico gives you all the ingredients for a perfect job: the right products, creative engineering, installation by expert crews. *Only* Plibrico gives you all three . . . but when you call for Plibrico service, you *know* you're getting your money's worth!

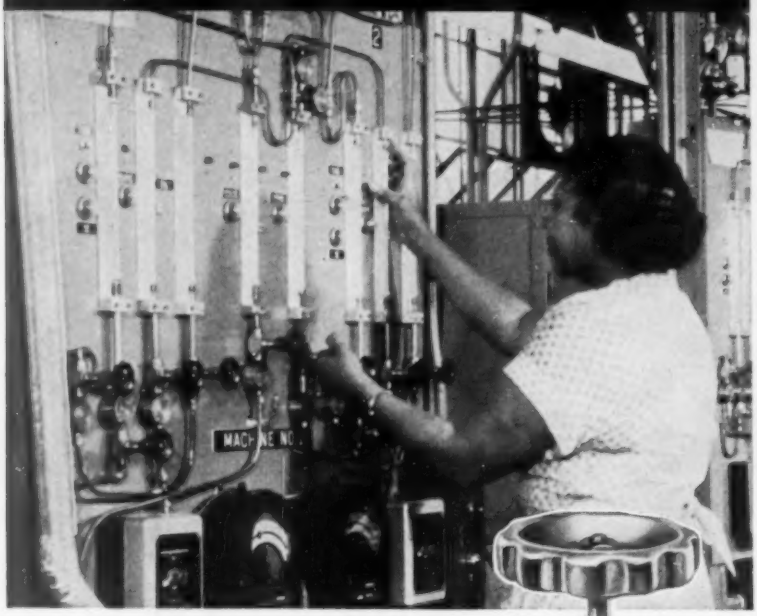
Plibrico Company

1824 Kingsbury Street • Chicago 14, Illinois

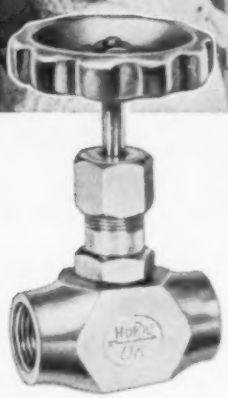
PLIBRICO SALES & SERVICE IN PRINCIPAL CITIES

(To obtain more data on advertised products see page 1260)

HOW TO MAKE PRECISION RESISTORS WITH NEEDLE VALVES



International Resistance Company process development engineers specify Hoke Needle Valves for precision control in Boron-Carbon resistor production



Excellent flow control...ability to meter corrosive gases...rugged... minimum maintenance...reasonable cost.

That's what IRC engineers say about the Hoke valves they're using to make their Boron-Carbon Precistors, vital components of today's complex electronic equipment.

In addition to needle valves, we make packless styles, toggle valves, bar stock types—just about the most complete line of small valves available. We'd like to help with your valve problems.

Write for complete information.

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Fluid Control Specialists

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What's New!

Mechanical Drive Turbines

. . . of company's type YR; *Bulletin H-22* has detailed presentation of design features, cross-sections of several applications, specifications; large photos and diagrams illustrate each feature. Steam Turbine Dept., Elliot Co., Jeannette, Pa.

Circle No. **47** *on Reply Card*

Centrifugal Pumps

. . . in capacities to 400 gpm. and heads to 230 ft. *Bulletin* 1001*B* has design features and specifications; also, maintenance advantages and full-page cutaway diagrams. De Laval Steam Turbine Co., Trenton 2, N. J.

Circle No. **48** *on Reply Card*

Did You Miss These?

The following items, reviewed originally in June, have aroused considerable interest among the readers. They are repeated briefly as a service to those who might have missed them the first time they appeared. For details or literature, please use the regular Reply Card in this issue

New Liquid Flow Meter Uses Electro-Magnetic Principle

. . . permitting measurement of a great variety of conductive liquids. Water and aqueous solutions, acids and other corrosive liquids, slurries, emulsions, opaque liquids, and liquids containing solids in suspension can be metered, as well as molten salts and liquid metals. The metering element consists only of an enclosed magnet, stainless steel tube with Teflon liner, and attached electrodes, which are connected to an indicator or a recorder remotely installed at any desired location. Pressure drop is no more than that for a length of pipe equivalent to the metering element. Limit of accuracy of the new "Xactronic" meter is rated at 1% of full scale reading; but under appropriate conditions an accuracy of 0.5% can be obtained. Instrument scale is linear. Six sizes, from ½ to 2 in., are available. Bowser, Inc., Fort Wayne, Ind.

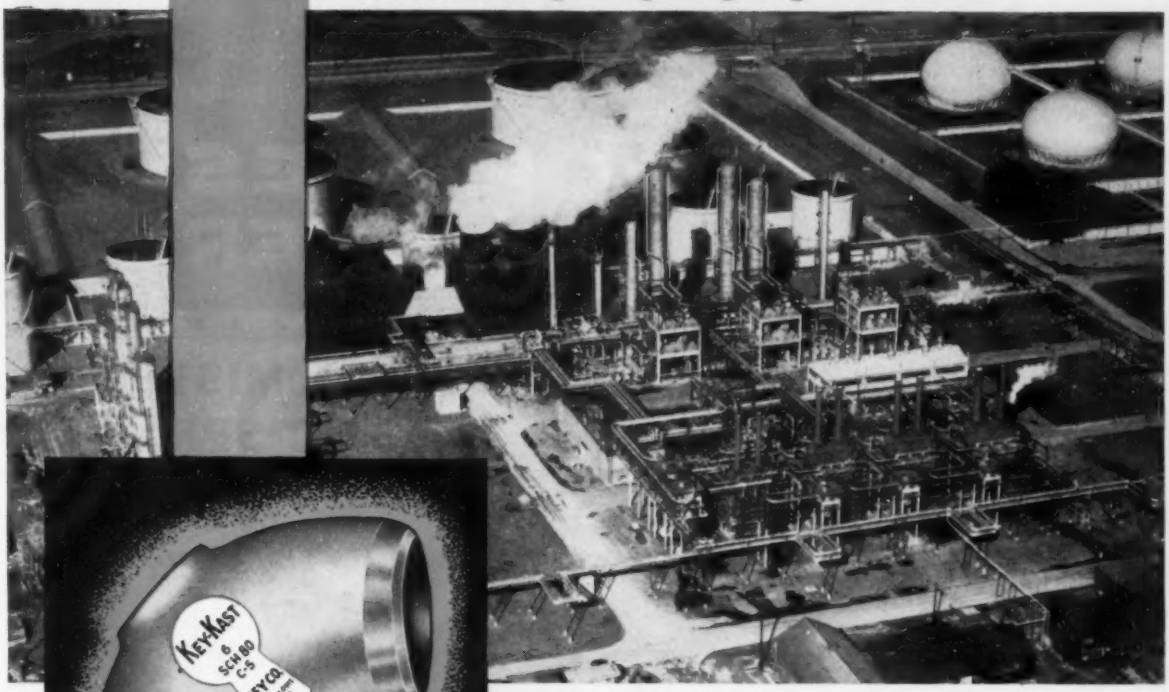
Circle No. **49** *on Reply Card*

Alloy Reference Chart

. . . listing the chemical analyses, physical properties, and recommended applications for 28 different grades of cast stainless steel. Cooper Alloy Foundry Co., Hillside, N. J.

Circle No. **50** *on Reply Card*

Higher Strength at Lower Cost for Alloy Piping Systems



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Serve NEW SUNOCO Marcus Hook Refinery

This well-ordered maze of steel piping and fractionating towers is Sun Oil Company's new petrochemical plant, located at the 1,900-acre Sunoco refinery at Marcus Hook, Pennsylvania. It produces aromatic chemicals for the synthetic rubber, plastic, detergent and other industries.

As added insurance against breakdown in the flow of these vital materials, Sun Oil Company chose sturdy, dependable KEY-KAST Welding Fittings to serve the piping system in this ultra-modern $15,000,000 plant.

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KEY-KAST FITTINGS ARE AVAILABLE IN EVERY SHAPE, SIZE, AND SCHEDULE IN LOW AND INTERMEDIATE ALLOYS AND VARIOUS STAINLESS STEELS

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(To obtain more data on advertised products see page 1260)

INCREASE throughput capacity
ELIMINATE costly liquid loss
IMPROVE overhead product quality
REDUCE harmful air pollution
with

YORKMESH DeMISTERS

CASE STUDY NO. 1003

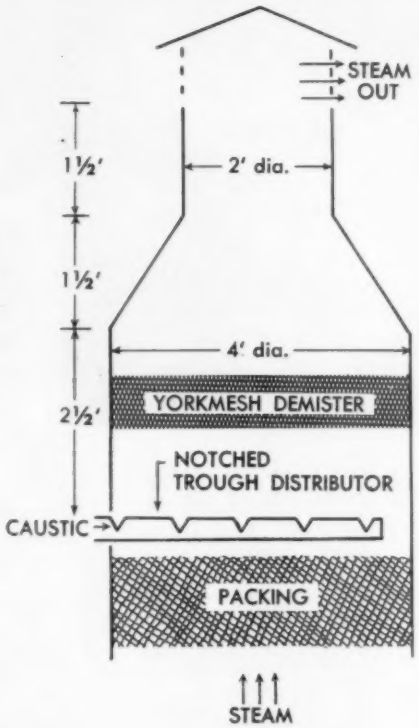
MONEL YORKMESH DeMISTER ELIMINATES CAUSTIC SPRAY

OBJECTIVE:
To eliminate an air pollution problem caused by a fine caustic spray from a scrubbing tower.

PROBLEM:
A four foot diameter tower employing caustic soda to scrub an organic material from steam gave rise to an objectionable finely divided caustic spray from the open top of the scrubber when operated at a steam rate of 3000#/hr.

SOLUTION:
A 6" thick monel Yorkmesh Demister was installed.

RESULTS:
The objectionable caustic spray on the surrounding area was eliminated entirely.



Note: for details and full description of installation write for case study No. 1003

YORK

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69 GLENWOOD PLACE. EAST ORANGE. N.J.

What's New!

Steam Tracer Integral With Pipe Solves Plant Problems

. . . such as those in the transfer of sluggish materials or tricky solutions. This is a new development by engineers of both Aluminum Co. of America and of Hercules Powder Co. Called "Unitrace," it consists essentially of an integrally extruded steam-traced aluminum pipe. Made as a single unit from Alcoa 3S-F alloy, it is slightly oval in cross section because of the crescent-shaped steam passage adjacent to the product line. Savings found in its original installation over conventional steam-jacketed lines in the 2-in. pipe size have amounted to 38¢/ft on material; 5¢/ft. on insulation; and a 30% reduction in labor costs, it is stated. Aluminum Co. of America, 1501 Alcoa Bldg., Pittsburgh 19, Penna.

Circle No. **51** *on Reply Card*

Organic Chemicals

. . . and their physical properties; *Catalog 54-1* contains full details on more than 80 commercial, semi-commercial and laboratory chemicals produced by the company. Sharples Chemicals, Inc., Widener Bldg., Philadelphia 7, Pa.

Circle No. **52** *on Reply Card*

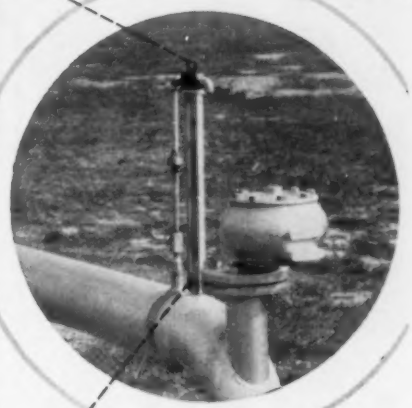
Stainless Steel

. . . in chemical processing; 34-page booklet describes its value in the manufacture of different chemical products, also contains corrosion resistance data, fabricating information, and selection guide. Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 19, Penna.

Circle No. **53** *on Reply Card*

For Your Convenience

Business reply cards are included in each issue of Petroleum Processing to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item. Then fill in the rest of the card and drop it in the mail. No postage is required.



MERIAM MANOMETER ACCURACY

Relied Upon in Gasoline Vapor Withdrawal from Field Tanks

Meriam Clean-Out Manometer indicates critical 1″ H_2O maximum vacuum desirable on this manifold system in storage field near Salem, Illinois. Pipe feeds off vapor from four 5,000 bbl. tanks.

● Meriam Manometer Accuracy is essential to safe, efficient tank depletion of gasoline vapor through a manifold system in a field at Salem, Illinois. Vapor is pulled from four 5,000 barrel tanks with about 1″ H_2O vacuum to the regulator. At the regulator it is stepped up to approximately 18″ mercury vacuum to the plant.

"An accurate manometer reading is highly important for a greater degree of vacuum could damage the tanks," says the superintendent.

This is another example of the importance of accuracy, sensitivity and dependability found in Meriam Manometers. They can be applied to many problems of pressure or flow indication in the petroleum and petrochemcial industries. If you have a problem write us or contact your MIT* Man. *Field photo courtesy Oil and Gas Jrn'l.*

*Meriam Instrument Technical Man

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(*To obtain more data on advertised products see page 1260*)

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This seems like an expensive way to find leaks when you consider that the leaks could be prevented by specifying Swagelok Tube Fittings.

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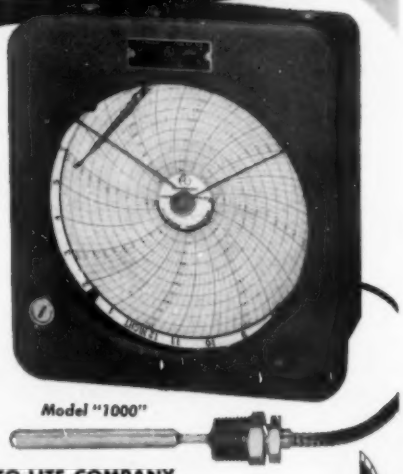
Send for new catalog describing many styles of Auto-Lite temperature Recorders and Indicators.



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EDITORIALS . . .

Statistics—Handle with Care!

OF late, we have seen increasing evidence that management is relying more and more on statistical methods in its handling of personnel problems. You have seen the tendency in such things as opinion surveys, in weighted averages on a great variety of subjects, and in many other ways.

What is "statistics," that it should command such attention?

Statistics is a branch of mathematics, an auxiliary science helpful in the development of ideas originating in the various branches of human knowledge. Collection and tabulation of data and their interpretation by estimating the average error using the square root instead of arithmetical averages are the functions of statistics.

Having no tool of its own for identifying the variables, statistics leads to curious conclusions puzzling to a human mind.

For instance, one of the insurance companies found by statistical methods that the average value of insurance carried by its clients is proportional to the average height of the insured; the importance of this conclusion to the progress of human knowledge is difficult to estimate. It must be admitted that an arbitrarily chosen variable which is independent of another variable has a much better chance of producing a smooth distribution curve than a logical variable. That anything can be proven by statistics is a well known maxim, as has been well said in the book, "How to Lie with Statistics"—by Huff.

The determination of an average error is a dangerous approach to logic. We all use statistics when we have reached the end of our wits in finding real correlations or have been too lazy to do it. Too often people accept a statistical answer believing that it is better than none; they forget that this stops our thinking process.

The use of statistics is particularly dangerous when it is applied to something as diversified as a human being. In our dynamic age of rapid developments an executive may have difficulty in following progress and is tempted to use statistics indiscriminately. Some may go so far as applying the mean square root of averages to the solution of personnel problems. Fortunately, for this executive, but not for the organization with which he is connected, statistics can average mechanical devices and human beings alike.

Statistics brings everything to a common level, except the statistician himself who is supposed to be the well of human knowledge. But so do socialism and communism which level everything—save their leaders.

Our dynamic society is based on an individualism which is in direct opposition to statistics. Whenever the leaders apply statistics in handling men, they create dissatisfaction and invite unions to take over the functions of an executive. A person who is handled as a number looks upon his supervisor as if he were also a number, a difficult concept for a man on top to understand and to swallow.

Statistics may simplify the life of an executive for a short while but it produces reactions which are of far-reaching consequences of which he is apt to be the first victim.

—a guest editorial
by V. A. Kalichevsky
Consulting Chemical Engineer

Lessons from the Past

THE lead feature article in this issue, pg. 1185, talks about the manner in which the Upper Midwest—the Dakotas, Minnesota, Wisconsin—is shaping up as a new area for relatively small refineries.

There have been several instances of new refineries being built in areas where large volumes of flush production were available. There was a short-lived refinery boom in Illinois when the Illinois Basin fields were developed in 1938-40. A more striking example was in East Texas in 1931-36. By the latter date about 100 plants had been built near the fields, most of them using only straight distillation, without even thermal cracking. They were put up to operate on cheap crude resulting from overproduction, and for a period high quality East Texas crude sold for 25¢ a barrel at the wellhead.

When pipeline outlets were adequate and the large companies began taking the oil, the days of cheap crude were over and most of the refineries built there in the boom folded up. By 1940 only 14 plants were listed as operating in East Texas. For most of the refineries built during the days of flush production, their inability to operate in competition with outside refineries when paying market prices for their crude was the chief cause of their failure.

There were other reasons, however. Their sales of products were purely on a price basis. They maintained no sales organizations worthy of the name, they developed no sales outlets of their own, they had no brand names for their products, and they carried on no advertising in their natural sales territories. When the crude market was stabilized and their price advantage gone, they had no means for holding their business against competition of better organized companies.

Conditions will be quite different for the refiners with new plants in the Upper Midwest. Their capital investments will be much larger for the type of refineries required to meet today's competition. Costs of producing crude in the new fields will be high and large investments will have to be made in pipe lines to transport the crudes to markets. Drilling and production will be regulated by the authorities in line with today's conservation practices.

The chief advantage of the new refineries going into the Upper Midwest will be some savings in transportation costs on their crudes and on their products moving into nearby natural markets. Even with this advantage, important though it may be, the companies there will have to have from the start efficient plant operations and strong sales departments to win out.

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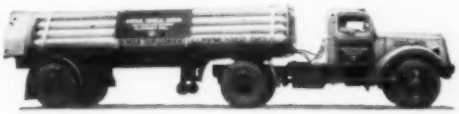
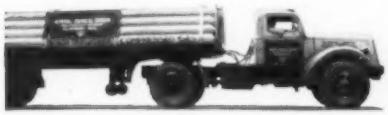


For Petroleum



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